

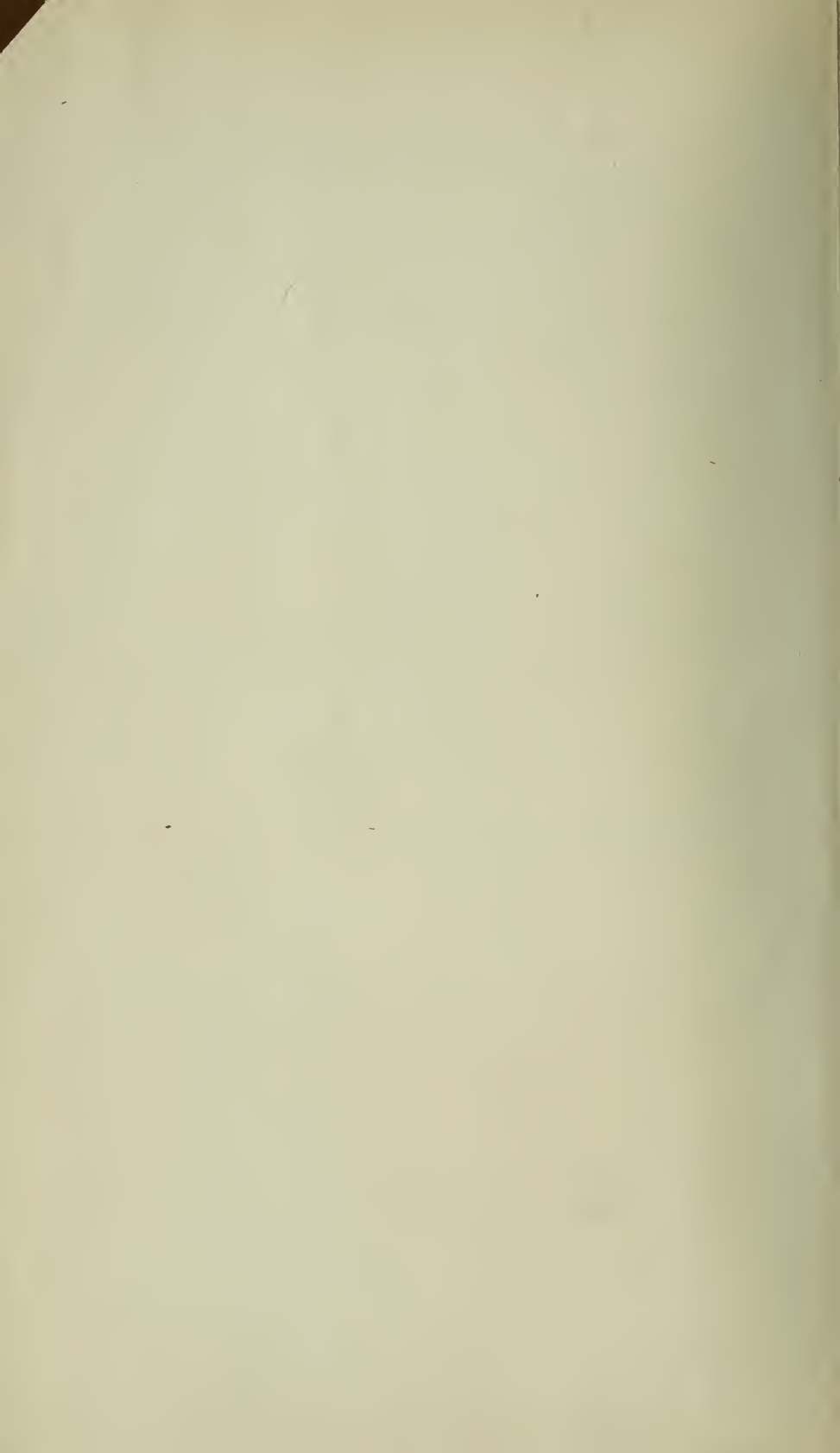
IRRIGATION IN UTAH

CHARLES HILLMAN BROUGH

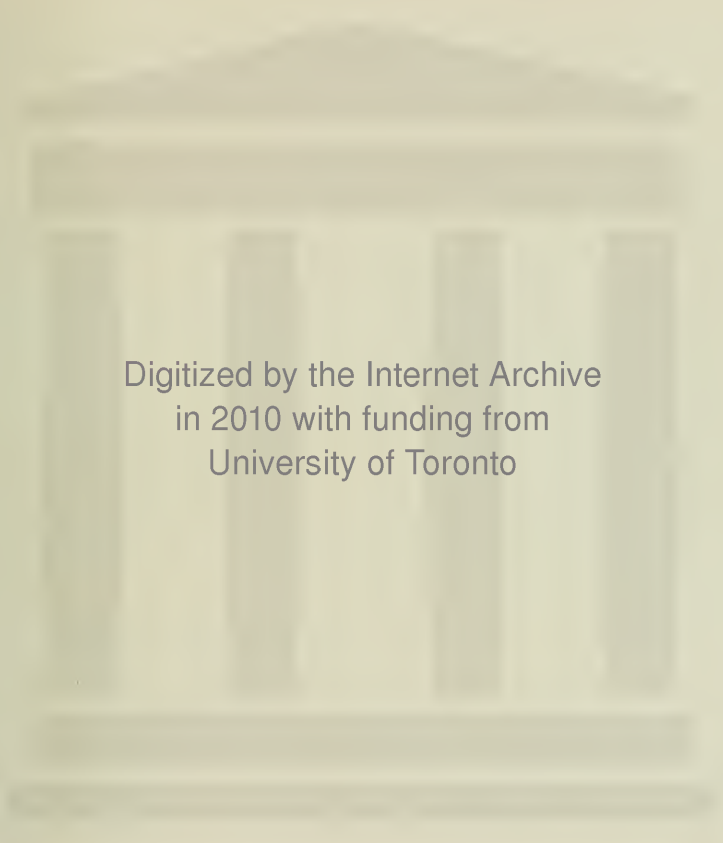


3 1761 07814947 3









Digitized by the Internet Archive
in 2010 with funding from
University of Toronto



THE FURROW METHOD OF IRRIGATION.

JOHNS HOPKINS UNIVERSITY STUDIES
IN
HISTORICAL AND POLITICAL SCIENCE
HERBERT B. ADAMS, Editor

History is past Politics and Politics are present History.—*Freeman*

EXTRA VOLUME
XIX

IRRIGATION IN UTAH

BY

CHARLES HILLMAN BROUGH

Fellow in Economics, Johns Hopkins University

BALTIMORE
THE JOHNS HOPKINS PRESS
1898

HD
1739
U8B7



786439

COPYRIGHT, 1898, BY THE JOHNS HOPKINS PRESS.

THE FRIEDENWALD CO., PRINTERS,
BALTIMORE.

TO

HONORABLE FRANK J. CANNON

UNITED STATES SENATOR FROM UTAH

THIS VOLUME IS DEDICATED IN RECOGNITION OF HIS DISTINGUISHED
SERVICES IN THE INTEREST OF IRRIGATION.



PREFACE.

A study of irrigation as practiced in Utah should prove of more than local interest: (1) Because Utah is the geographical centre of the Arid Region and what has been done there is a fair test of average possibilities. (2) Because both the co-operative and capitalistic methods have been applied in the reclamation of arid land in Utah, and an opportunity is afforded for comparing the results of the two methods. (3) Because problems applicable to the Arid Region as a whole are considered and their solution is attempted.

Of these problems the most important are the cession of the lands now in the hands of the United States Government to the States and Territories in which they are situated, the formulation of a plan by which lands already ceded to the States and Territories may be reclaimed, and the question of state control of water.

The most important general sources on which this study is based are: (1) Manuscript historical records of the Mormon Church, found in the church library at Salt Lake City, Utah. (2) Files of Utah newspapers, including the Deseret News, the Salt Lake Tribune and Herald, and the Ogden Standard. (3) Works on irrigation as practiced in foreign countries, found in the library of the Geological Survey, Washington, D. C. (4) Files of the Irrigation Age, Industrial Reporter, and other irrigation journals. (5) Reports of the proceedings of irrigation congresses and conventions, reports of state engineers, bulletins of agricultural

colleges and experiment stations, etc. (6) Reports issued by the United States Government on irrigation, especially the Eleventh Census Report, Agriculture by Irrigation, by F. H. Newell, and the Special Senate Report of the Committee on the Reclamation of Arid Lands, 6 vols., 1890. Other sources used will be found enumerated in the complete bibliography appended, and specific references will be indicated in footnotes. Valuable information has also been gathered from correspondence and interviews with irrigators and persons interested in irrigation throughout the Arid Region.

For assistance in gathering materials my special thanks are due to the Honorable Frank J. Cannon, United States Senator from Utah; Apostle Franklin D. Richards, Librarian of the Mormon Church; F. H. Newell, Chief Hydrographer of the United States Geological Survey; Professor Samuel Fortier, of the Utah Agricultural College; Judge L. W. Shurtliff, Chairman of the Utah Irrigation Commission; Col. C. L. Stevenson, Secretary, Utah Irrigation Commission; W. H. Rowe, Ex-President of the Bear River Irrigation and Ogden Waterworks Company; James A. Wright, President of the Utah State Board of Horticulture; Joseph P. Bache, State Statistician; Bishop C. F. Middleton of Ogden; Elwood Mead of Wyoming; F. J. Mills of Idaho; Donald W. Campbell of Colorado; William Hammond Hall of California; William R. Akers of Nebraska, and other irrigation engineers.

I also wish to acknowledge helpful criticisms and suggestions as to the manner of presenting the results of my study and as to its form of publication made by Dr. Sidney Sherwood, Dr. J. H. Hollander and Professor Herbert B. Adams of the Johns Hopkins University.

CONTENTS.

PART I.

THE ECONOMIC HISTORY OF IRRIGATION IN UTAH.

	PAGE
INTRODUCTION.....	1
CHAPTER I. THE FORMATION OF THE CO-OPERATIVE SYSTEM (1847-1848).	
First crude attempts at irrigation.....	7
Description of initial methods of diverting water.....	9
Distinctive features of the co-operative system.	
(a) Water rights appurtenant to land.....	12
(b) Co-operative labor.....	12
(c) Village communities.....	14
(d) Small farm unit.....	18
(e) Diversified production.....	19
(f) Production for home consumption.....	19
CHAPTER II. ECONOMIC DEVELOPMENT UNDER THE CO-OPERATIVE SYSTEM (1848-1862).	
Suppression of speculation in land values.....	22
Introduction of money as a result of large harvests.....	24
California gold-seekers and improved processes of production....	26
The Utah war: its effect on irrigation.....	32
Construction of co-operative canals.....	33
CHAPTER III. EARLY LEGISLATION (1862-67).	
The Homestead law, May 20, 1862.....	35
The Utah District law, January 20, 1865.....	36
Priority of rights system.....	41
CHAPTER IV. TRANSPORTATION AND COMMERCE AS AIDS TO IRRIGATION (1867-1877).	
Construction of railroads and the extension of the market.....	45
Commercial co-operation and its relation to irrigation.....	50

	PAGE
CHAPTER V. RECENT LEGISLATION (1877-1897).	
The Desert Land Act, March 3, 1877.....	55
The Enabling Act, July 16, 1894.....	58
The Carey Act, August 18, 1894.....	56
Legislation of 1897.....	59
CHAPTER VI. CAPITALISTIC IRRIGATION (1890—).	
Rise and growth of capitalistic irrigation.....	63
Names of irrigation corporations, when incorporated, land irrigated, capital stock invested.....	66
Comparison of the profits of co-operative and capitalistic irrigation.....	71
CHAPTER VII. DEVELOPMENT OF AGRICULTURE THROUGH IRRIGATION.	
Tables showing agricultural development.....	74
Comparison of yields by dry farming and irrigation.....	83
Crops of Utah: their varieties and yields.....	84
CHAPTER VIII. DEVELOPMENT OF HORTICULTURE THROUGH IRRIGATION.	
History of horticulture in Utah.....	89
The commission system.....	91
Fruits of Utah: their varieties and yields.....	92
CHAPTER IX. RELATION OF IRRIGATION TO OTHER FACTORS OF UTAH'S INDUSTRIAL SYSTEM.....	96
CONCLUSIONS.....	100

PART II.

PROBLEMS OF IRRIGATION IN UTAH.

INTRODUCTION. STATEMENT OF PROBLEMS.....	105
CHAPTER I. ADVANTAGES OF RECLAIMING THE REMAINING IRRIGABLE LAND.....	108
CHAPTER II. METHODS OF RECLAIMING THE WHOLE BODY OF IRRIGABLE LAND.	
Reclamation under the present land laws.....	116
Reclamation by the general government through appropriations and surveys.....	118
State cession in trust.....	125

Contents.

xi

	PAGE
CHAPTER III. ADMINISTRATION OF THE IRRIGABLE LAND ALREADY CEDED TO THE STATE.	
Reclamation by the State itself.....	137
Reclamation by public corporations with Water Districts organized under the laws of the State.....	141
Reclamation by private enterprise operating under grants from the State with proper restrictions imposed upon the grants....	152
CHAPTER IV. STATE CONTROL OF WATER.	
Evils of the Priority of Rights System.....	160
Advantages of a State Board of Control.....	165
CHAPTER V. NECESSITY FOR MORE ACCURATE MEANS OF MEASURING WATER.....	169
CHAPTER VI. THE MARKETING OF IRRIGATION PRODUCE.....	172
APPENDIX.	
(A) Utah's water supply, storage reservoirs and amount of irrigable land.....	178
(B) Sub-irrigation <i>versus</i> surface irrigation.....	188
(C) Table showing length of irrigation season, number of waterings required, etc.....	189
(D) Names of incorporated canal companies in each county, when incorporated, capital stock invested, number of shares, etc.....	190

LIST OF ILLUSTRATIONS.

The Furrow Method of Irrigation.....	Frontispiece
An Irrigation Flume.....	facing page 32
Bear River Canal, showing Spillway.....	“ 32
Bear River Canal, showing Stone Cut and Tunnel.....	“ 64
A Main Canal and Lateral.....	“ 102
Dam and Headgate of an Irrigation Canal.....	“ 152



AUTHORITIES CONSULTED.

PART I.

THE ECONOMIC HISTORY OF IRRIGATION IN UTAH.

- AGRICULTURAL COLLEGE OF UTAH. Annual Reports and Bulletins of Experiment Station. Logan, 1890 et seq.
- BACHE, JOSEPH P. First Triennial Report of State Statistician. Salt Lake City, 1895.
- BANCROFT, H. H. History of Utah. San Francisco, 1889.
- BUSCH, M. Geschichte der Mormonen. Leipsic, 1870.
- CAINE, JOHN T. Irrigation. Article in Dana's "Great West." Denver, 1889.
- CANNON, GEORGE Q. The Mormon Land System. Denver, 1894.
- CONTRIBUTOR, FILES OF. Salt Lake City, 1879 et seq.
- DESERET NEWS, FILES OF. Salt Lake City, 1850 et seq.
- FABIAN, BENTHAM. Resources of Utah. Salt Lake City, 1874.
- FORTIER, SAMUEL. Seepage Waters of Northern Utah, Water Supply Papers, U. S. Geological Survey, No. 7. Washington, 1897.
- GUNNISON, J. W. The Mormons, or Latter-day Saints. Philadelphia, 1852.
- HOLLISTER, O. J. Resources and Attractions of Utah. Salt Lake City, 1882.
- HORNE, MRS. M. J. Migration and Settlement of the Latter-day Saints. MS.
- IRRIGATION COMMISSION OF UTAH. Report to Third National Irrigation Congress. Denver, 1894.
- KENNISON, ROBT. L. Irrigation in Utah. Washington, 1871.
- KINNEY, CLESSON S. On Irrigation, Water Rights, Appropriation of Waters. Washington, 1894.
- MEARS, GEORGE A. Prize Essay on Utah. Salt Lake City, 1872.
- NEWELL, F. H. Agriculture by Irrigation, Eleventh Census. Washington, 1890. Census Bulletin, 1891.
- NIMMO, JOSEPH, JR. Uncle Sam's Farm. Washington, 1890.
- OGDEN STANDARD, FILES OF. Ogden, 1875 et seq.
- OLSHAUSEN, THEODOR. Geschichte der Mormonen. Göttingen, 1856.
- POWELL, J. W. Report on Lands of Arid Region. Washington, 1879.
- PRATT, PARLEY. Autobiography. New York, 1874.

- REASONER, CALVIN. *Reminiscences*. MS.
 RICHARDS, FRANKLIN D. *Narratives*. MS.
 SALT LAKE HERALD, FILES OF. Salt Lake City, 1875 et seq.
 SALT LAKE TRIBUNE, FILES OF. Salt Lake City, 1875 et seq.
 SHOEMAKER, JOEL. *Co-operative Irrigation*. Manti, 1894.
 SMITH, GEO. A. *Rise, Progress and Travels of the Latter-day Saints*. Salt Lake City, 1872.
 SMYTHE, WILLIAM E. *The Mormon Industrial System*. Atlantic Monthly, November, 1896.
 STEVENSON, C. L. *Irrigation Statistics*. Salt Lake City, 1891.
 UNITED STATES. *Reports of Department of Agriculture*, 1862 et seq.; *Reports of Census Bureau*, 1850 et seq.; *Reports of Geological Survey*, 1889 et seq.
 UTAH, BOARD OF TRADE. *Resources and Attractions*. Salt Lake City, 1879.
 UTAH. *County Sketches by various authors*. MS.
 UTAH. *Journals of Council and House*, 1851 et seq.
 UTAH PIONEERS. Salt Lake City, 1880.
 WELLS, DANIEL H. *Journal*. MS.
 WHITNEY, ORSON F. *History of Utah*. 2 vols. Salt Lake City, 1890.
 WOODRUFF, WILFORD. *Journal*, MS.; *My Twenty Acre Farm*. Salt Lake City, 1894.
 YOUNG, BRIGHAM. *History and Private Journal*, MS.; *Journal of Discourses*. Liverpool and London, 1854 et seq.
 ZABRISKIE, J. C. *Public Land Laws of the U. S.* San Francisco, 1870.

PART II.

THE PROBLEMS OF IRRIGATION IN UTAH.

- LETTERS FROM IRRIGATORS IN UTAH AND OTHER STATES AND TERRITORIES OF THE ARID REGION.
 BAROIS, J. *Irrigation in Egypt*. Paris, 1887. Trans. by Maj. A. M. Miller, Washington, 1889.
 HALL, WILLIAM HAMMOND. *Irrigation Development*. Sacramento, 1886.
 INDUSTRIAL REPORTER, FILES OF. Denver, 1892 et seq.
 IRRIGATION AGE, FILES OF. Chicago, 1891 et seq.
 IRRIGATION CONGRESSES, PROCEEDINGS OF. 1891 et seq.
 IRRIGATION STATE CONVENTIONS, PROCEEDINGS OF.
 IRRIGATION. *Special Senate Report, Committee on the Reclamation of Arid Lands*. 6 vols. Washington, 1890.
 MALAPERT, PIERRE ANTOINE FREDERIC. *Code complète de l'expropriation pour cause d'utilité publique, précédé d'une instruction et suivi de modèles ou formules des actes que nécessite l'expropriation*. Paris, 1856.

NADAULT, DE BUFFON BENJAMIN. Des Canaux d'arrosage de l'Italie septentrionale, dans leur rapport avec ceux du midi de la France. Traité theorique et pratique des irrigations envisagées sous les diverses points de vue de la production agricole, de la science hydraulique et de legislation. 3 vols. Paris, 1844.

Cours d'agriculture et d'hydraulique agricole, comprenant les principes généraux de l'économie rurale, etc. 4 vols. Paris, 1879.

REPORTS OF STATE ENGINEERS OF CALIFORNIA, COLORADO, IDAHO, NEBRASKA AND WYOMING.

WILCOX, LUTE. Irrigation Farming. New York, 1895.

WILSON, H. M. Irrigation in India. Transactions American Society of Civil Engineers, Vol. 23. New York, 1890.

PART I.

THE ECONOMIC HISTORY OF IRRIGATION IN UTAH.

INTRODUCTION.

A treasured historical painting in Salt Lake City pictures the Mormon pioneers of 1847 in the act of turning the mountain stream now known as City Creek upon the alkaline desert. This picture commemorates the first attempt made by the Anglo-Saxon race to reclaim arid land.¹ Earlier traces of irrigation, even in the New World, are to be found in the gardens of the mission fathers of southern California, in the canals of the aborigines of Arizona, in the magnificent aqueducts of the Mexicans and Peruvians, and in the utilization of the water of creeks by various Indian tribes.²

¹ Clesson S. Kinney, *Irrigation, Water Rights and Appropriation of Waters*, 30; Joseph Nimmo, Jr., *Uncle Sam's Farm*, 18. The only apparent exception to the above statement is the case of the rice farms of South Carolina. These farms, however, were flooded rather than irrigated.

² In the Salt and Gila valleys of Arizona an immense network of prehistoric canals is to be found. The age of these canals is a matter of speculation, but it is well known that the aborigines who inhabited that section of the country had attained a high degree of civilization. There is a tradition among the present Indian tribes concerning the destruction of these canals. When Coronado in 1542 was seeking the seven cities of Cibola, he found several tribes of aborigines in what is now Arizona, supporting themselves wholly or in part by tilling the soil. These tribes themselves occupied but a limited area; but widely scattered groups of ruins prove that in the earlier centuries all of the principal valleys were inhabited by numerous people who lived chiefly by agriculture.

2 *The Economic History of Irrigation in Utah.*

As a matter of fact, irrigation is one of the oldest arts; according to one writer it antedates drainage, and by another it is made the distinctive feature of the middle status of barbarism.¹ It is a striking and interesting fact that the most prosperous nations of antiquity, those farthest advanced in the arts, the sciences and in culture, had their rise and existence in arid regions. Egypt has been happily called "the gift of the Nile"; for it was by the annual overflow of this river, aided by an extensive system of dikes, canals and reservoirs, that she became the "granary of the world."² Three great monarchies—Chaldea, Assyria and Babylonia—rose to prominence and dominion in the valley of the Tigris and Euphrates, where the climate is almost rainless.³ China had its artesian wells for irrigation more than 3000 years before the art was first introduced into the United States. In Italy irrigation came down through Lombardy and Piedmont from the Romans, who built extensive canals and reservoirs. The Moors constructed irrigating works in Spain a thousand years ago, and agriculture is carried on there to-day under substantially similar governmental regulations. Before the days of Solomon a canal irrigated the valley of Mareb. Numerous other historical examples might be cited to prove the importance of irrigation as a factor in nation-building;

For irrigation as practiced in Mexico and Peru, cf. Mitchell, *Past in the Present*, 211; Tylor, *Early History of Mankind*, 184; Prescott, *Conquest of Peru*, i, 7.

¹ Morgan, *Ancient Society*, II.

² Historians differ considerably as to when and where the art of irrigation was first practiced—whether in the Valley of the Nile, in China, in Armenia along the shores of the Mediterranean, among the Incas of Peru, or the Nahna Nations which include the Toltecs and Aztecs in Central America, Mexico and Arizona. But through the media of numerous monumental tablets, sarcophagæ, potsherds and papyrus rolls, modern research has been able to carry the clear and consecutive history of Egypt farther back than that of any other country, and therefore Egypt is generally considered the birthplace of irrigation.

³ The prophet Jeremiah evidently refers to the vast irrigating system of Babylonia in the words, "O thou that dwellest upon many waters, abundant in treasures." (Jeremiah 2: 13.)

suffice it to say, that when the Mormons entered Salt Lake Valley it is estimated 138,250,000 acres had been reclaimed in the various countries of the world, supporting in the main 800,000,000 people.¹

In view of this array of historical evidence in favor of its utility, it would seem to be a racial enigma that the Anglo-Saxon race never attempted the reclamation of arid land until 1847. Perhaps this can be explained on the theory that the Germanic peoples have always written history faster than they have read it. Their lust for conquest and territory that could be easily cultivated gave them no time to speculate on the achievements of older civilizations. At any rate, from the first allotment of land tenures in the Middle Ages to the colonization of the New World, we find the conquering Saxon occupying the humid lands of the north, while his weaker Romance rival was pushed down to the arid lands farther south.

There is little reason to believe that Brigham Young had any previous knowledge of irrigation when he entered Salt Lake Valley. The region around Nauvoo, Illinois, from which the Mormons were driven by the United States authorities, typified the agriculture of the humid region. When the bitter factional feud between Mormons and anti-Mormons was at its height in Illinois, and it seemed necessary for the Mormons to abandon their property and commence their migration westward, Brigham suggested Vancouver Island as their future home. This is additional proof of the theory that he had no previous knowledge of the art of irrigation, because the soil of Vancouver Island is not arid.

Yet the great leader did not fail to anticipate the contingencies which might arise in an unknown region. Before leaving Nauvoo he embodied the following agrarian laws in the Mormon Torah: "Let each company with their captains and presidents decide how many can go; and then choose out a sufficient number of able-bodied and

¹ Joseph Nimmo, Jr., *Uncle Sam's Farm*, 14.

4 *The Economic History of Irrigation in Utah.*

expert men to take teams, seeds and farming utensils to go as pioneers to prepare for putting in spring crops."¹ The Mormons, who placed implicit confidence in the wisdom of Brigham Young, obeyed instructions, with the result that on February 15th, 1846, the date of their migration to the then trackless west, they had converted all their houses and furniture into live stock and potato seed, and filled their wagons with plows and harrows.² When the band of 148 pioneers entered the valley of the Great Salt Lake on July 24th, 1847, this wealth had dwindled to teams, household goods and a swarm of women and children, and there was no vestige of their former political prestige save the presence of a wonderful colonizer. The hardships suffered in crossing what was then the Great American Desert on the map were not limited to hunger and sickness, but included Indian depredations and attacks. The utmost vigilance was necessary. The exiles traveled in compact companies called "hundreds." Every man was ordered to carry his gun loaded at all times, the locks to be shut on a piece of buckskin, with caps, flintlocks and flasks ready in case of attack. Wagons were formed two abreast, each

¹ Orson F. Whitney, *History of Utah*, i, 402; *Times and Seasons*, vi, 1018.

² An instance is related where a Mrs. Wells sold her two-story brick house, which had been occupied but three months, "for two yoke of half-broken cattle and an old wagon." Wells, *Narrative*, MS., 37.

H. H. Bancroft (*History of Utah*, 217) says there is no parallel in the world's history, with the possible exception of the wanderings of the Pilgrim Fathers, to the migration of the deeply religious people from Nauvoo. There are substantial reasons for such a belief. Before their expulsion from Illinois the Mormons were materially prosperous and politically powerful. Brigham Young (*History of Brigham Young*, MS., 1846, 35) observes that enough grain had been accumulated by the Mormons, prior to their exodus, to feed the whole population for two years, and another writer (Richards' *Reminiscences*, MS., 20) testifies that over 2000 houses were sold at auction before leaving. As illustrating their political power, it may be said that in 1844 Joseph Smith was nominated as candidate for President of the United States in opposition to Henry Clay and James K. Polk, both of whom refused to guarantee the new sect protection in case of election.

man being ordered to walk beside his own wagon.¹ However, the pioneers bore their burdens bravely, and at intervals between prayers and fighting used to sing, "O California, that's the land for me, it lies between the mountains and the great Pacific sea."

Why a country whose approach was so dangerous and whose wildernesses were so uninviting should have been selected as the seat of the new Zion is difficult to understand. Several causes probably conspired to produce this result. Religious exclusiveness was the animus underlying the choice. Brigham Young was seeking just such a land as Utah, midway between the Missouri and the Pacific, where he might work out his religious and social problems unmolested. This feeling of religious exclusiveness is forcibly illustrated by the following proclamation published early in the official organ of the Church: "The exodus of the nations of the only true Israel from the United States to a far distant region of the west, where bigotry, intolerance and insatiable ambition will have lost their power over them, forms a new epoch, not only in the history of the Church, but of the Nation."² Shortly after the publication of this proclamation a report of General John C. Fremont describing the intermountain country fell into the hands of Brigham Young. Joseph Smith had predicted that in the future his people should become numerous in the Rocky Mountains,³ and no doubt this revelation also influenced them in the selection of "the Great Basin of Upper California" as their future home.

But on reaching what they had hoped to be an El Dorado, teeming with gold and silver and fertile fields, even

¹ Taylor's Reminiscences, MS., 19.

² Times and Seasons, vi, 1018.

³ "I prophesy that the Saints will continue to suffer much affliction, and will be driven to the Rocky Mountains. Many will apostatize; others will be put to death by our persecutors, or lose their lives in consequence of exposure or disease; and some will live to go and assist in making settlements and building cities, and see the Saints become a mighty people in the midst of the Rocky Mountains." Joseph Smith at Montrose, Iowa, August 6th, 1842.

6 *The Economic History of Irrigation in Utah.*

the most hopeful member of that motley army of industrials must have felt inclined to question the clearness of his prophet's revelation. No waving fields, no swaying forests, no verdant meadows rested and refreshed the wearied eye. An eloquent church historian has described the scene as "a desolation of centuries, where earth seemed heaven-forsaken, where hermit Nature watching, waiting, weeped, and worshiped God amid eternal solitude."¹ With their supplies of vegetables exhausted, with their able-bodied workmen decimated by the dread disease of scurvy, with the flower of their company summoned to serve as a battalion in the Mexican War, the transformation of this sterile waste glistening with beds of salt and soda and deadly alkali seemed impossible. No wonder that the companies which were delegated as the first surveyors of arid America returned with the report that "although they had staked off land suitable for crops, no crop could be grown because the soil was friable and composed of loam and gravel."²

The leaders of this peculiar though industrious hierarchy proved, however, that they were organizers of no mean quality. Driven beyond the confines of civilization into a country filled with hostile Indians, forced to agriculture simply because it was necessary that they should eat, with a limited knowledge of planting and sowing, with a thousand miles between them and an inhabited outpost, heart-sick, weary and worn out by their thousand-mile journey, with the knowledge that they had literally burned their bridges behind them, with the fact staring them in the face that in the estimation of the world their hands were against every man and every man's hands were against them—in spite of all these difficulties and vicissitudes, Brigham Young and his little band of colony-builders resolved to build a noble edifice of economic fact, reared by human toil and held firmly in place by the average prosperity of all who had part in its building.

¹ Orson F. Whitney, *History of Utah*, i, 220.

² *Hist. Brigham Young*, MS., 1847, 99.

CHAPTER I.

THE FORMATION OF THE CO-OPERATIVE SYSTEM (1847-48).

On July 24th, 1847, William Carter, one of the members of Pratt's hundred, undaunted by the report of the first surveying committee, dedicated a tract of arid land to the Lord, cut a trench which would convey the waters of City Creek to the field, planted a few potato seeds, and prayed that the labors of the Saints might be blessed.¹ The ground was so dry that it was necessary to irrigate it before ploughing. The irrigation contagion soon spread, and although a thunderstorm interrupted to some extent their energetic labors, Pratt and his company commenced mowing the grass and preparing a turnip patch. The summer season was not favorable to successful irrigation, yet a field of five acres was broken up in order to preserve the potato seed.²

These were the crude and hopeless beginnings of a system that has made the produce of the western farm a competing force in the world's market. The success of the potato experiment, as was seen in the crop of the following fall,³ convinced those hardy pioneers that irrigation was to

¹ There is some doubt as to who was really the pioneer irrigator of Utah. George W. Brown, now residing at Charleston, Wasatch County, Utah, writes: "We moved camp from Emigration Creek to City Creek near where the Deseret Bank (Salt Lake City) now stands. . . . Orders were given to begin ploughing. A rush was made to begin. I succeeded in being the first one to hitch up. John S. Eldridge furnished the plow. I picked up my whip and both drove and held the plow and turned the first sod in Utah Territory."

William Carter, of St. George, Washington County, writes: "I ploughed about a half an acre before any other teams came." Carter's claim is substantiated by Bancroft, *History of Utah*, 261; also by Whitney, *History of Utah*, i, 331.

² Wilford Woodruff, *Utah Pioneers*, 23.

³ "For while the crops, planted so late, did not mature, yet a few small potatoes from the size of a pea upwards to that of half an

8 *The Economic History of Irrigation in Utah.*

be the source of all their wealth and that the mountain reservoirs of nature should be most carefully and systematically guarded. Brigham Young, scorning the advice of Colonel Bridger, who offered to give him ten dollars for every ear of corn that could be grown in the arid region,¹ advised his followers to construct co-operative canals, open individual ditches and apply water to the land that native fruits and cereals might be produced in sufficient quantities to supply the demand for home consumption.² To the requests of some who wished to go to the mountains and mine gold and silver, the leader replied that it was more important that the waters of the mountain should be appropriated and distributed among the fields of the agricultural husbandman.³

The winter of 1847, though severe on the ill-fed and ill-clothed pioneers, was a season of activity. Every one was ploughing and sowing, furrows were made on one side of the bench landing while snow was on the other, and it was a common sight to see men working out of doors in February in their shirt sleeves.⁴ Natural streams were protected, springs developed, and the year of reclamation, the results of which constitute one of the most wonderful strides of civilization, began to dawn upon the beautiful valleys of Utah. "We have accomplished more this year (1847)," writes Wilford Woodruff, "than can be found on record

inch in diameter were obtained as excellent seed for another year's planting." Whitney, *History of Utah*, i, 337.

¹ "James Bridger, who had a trading post which still bears the name of Fort Bridger, when he met the President on the Big Sandy River about the last of June (1847), and learned that his destination was the valley of the Great Salt Lake, offered \$1000 for the first ear of corn raised there. 'Wait a little,' said the President, 'and we will show you.'" Snow, *Utah Pioneers*, 33 am., 44.

² *Utah Early Records*, MS., 112; *Contributor*, xi, 240.

³ On the 7th of December, Brigham writes in his Journal: "Some few have caught the gold fever; I counseled such, and all the Saints, to remain in the valleys of the mountains, make improvements, build comfortable houses, and raise grain against the days of famine and pestilence with which the earth would be visited."

⁴ *Horne's Migration*, MS., 24.

concerning an equal number of men in the same time since the days of Adam. We have traveled with heavily laden wagons more than a thousand miles over rough roads, mountains and canyons, searching out a land, a resting place for the Saints. We have laid out a city two miles square, and built a fort of hewn timber seven miles from the mountains and of sun-dried bricks or adobes, surrounding ten acres of ground, forty rods of which were covered with blockhouses, besides planting ten acres of corn and vegetables."¹

Some time in December, 1847, \$10,000 in Spanish doubloons were brought into the territory by a Captain James Brown, a bishop of the church who had become wealthy by mining gold in California. This was the first money put in circulation among the Mormon colonists with the exception of a few coins remaining to them after purchasing the outfits with which they crossed the plains.² Naturally this increase in their circulating medium, and the mild season which marked the beginning of the year 1848, inspired confidence in the ultimate success of their irrigation enterprises. In the spring of 1848, 5153 acres of land were brought under cultivation, 872 of which were sown with winter wheat and the rest in vegetables.³ The limited means of the pioneers would not permit them to conquer large rivers and construct expensive storage reservoirs at this formative period in their history, so they utilized the small mountain streams of the canyons.

The methods of irrigation pursued by these conquerors of the desert, unaided by capital or previous experience, were almost identical with those in vogue at the present day.⁴ Canals were run from the canyons out upon the more level land of the valleys and there subdivided into branch

¹ Woodruff's Journal, MS., 78.

² Bancroft, History of Utah, 290; Whitney, History of Utah, i, 374.

³ Utah Early Records, MS., 20-21.

⁴ For description of present methods of irrigation in Utah, cf. Report of the Utah Irrigation Commission to the Third National Irrigation Congress, Denver, 1894, 7.

10 *The Economic History of Irrigation in Utah.*

canals, and these again divided into laterals leading to every farm so long as there was water to be distributed. Each farmer had canals leading from the main one to every field, and generally along the whole length of the upper side of each field. Each field had little furrows, a foot or more apart and parallel with each other, running either lengthwise or crosswise or diagonally across, as the slope of the land required. Into these furrows the water was turned, one or more at a time, as the quantity of water permitted, until it had flowed nearly to the other end, when it was turned in the next furrows, and so on until all were watered.

This was the usual custom then, as it is now, but sometimes the pioneers encountered clay soil through which the water would percolate, and other methods would necessarily have to be adopted. A plan which was frequently resorted to was to throw up little embankments six inches high around separate plats of land that were of uniform level, and turn the water in until the plat was full to the top, when the water was drawn off to the next lower plat, and so on until the end. This enabled the water to soak in more and did the crop more good. Each farmer was given the right to use the water so many hours once a week, the amount of water allotted to each person being proportionate to the amount of land he cultivated.¹ It was tacitly understood that "a share of water" would fluctuate in size according as the season was wet or dry, and that the quantity of crops sown would be governed somewhat by the water supply of the season.

The method of dividing the water, depending to a large extent upon the intelligence of the irrigators, was to put in a dam at the head of the canal on the stream, with a par-

¹ The amount of water to be used is generally estimated on a scale of cubic feet, or miners' inches, and the number of these cubic feet depends on what is technically known as the "duty of water." Naturally, this duty varies in different States and in different parts of the same State. A cubic foot of water in Utah will irrigate 100 acres, therefore the duty of water in Utah is said to be 100.

tition in it separating the proper share for the canal, the rest being allowed to flow down the channel of the stream.¹ In constructing the dams or throwing the water into a lateral ditch, teams and plows were used. Sometimes, after half a dozen or more plows, the pioneers would run an immense wedge-shaped plow, constructed of logs a rod long, called a "go-devil." It was sharp at the point and wide at the rear, and threw the earth upon the sides; being very ponderous, it was drawn by a train of oxen. More frequently they divided the work into sections, and gave each man a rod of ditch-work to clean up with a shovel after each run of the plows over his rod. If there were a hundred men to shovel, the plows would run continuously through a hundred rods and then return, thus running to and fro until the section was completed. The ditch would probably be from four to six feet at the bottom and twice as much at the top, with a depth corresponding with the bottom width, unless the unevenness of the ground required a broader cut upon the surface.

The ingenuity of the pioneers in the use of surveying instruments was amusing, but practically effective.² The wooden triangle and plumb was one instrument. Sometimes rude water-levels were constructed with wooden pipes and bottles at the ends into which the water from the pipes would run and by gravity establish an exact level in the bottles, from which they could take levels all over the country. Bishop Davis James says that at first, in running lines, he took a broad milk-pan, filled it to the brim with water and ran his lines from its level surface.

No provisions were made against seepage,³ nor any for

¹ Journal of Discourses, i, 383.

² For description of the mechanical features of the early system of irrigation in Utah, cf. Calvin Reasoner's *Reminiscences*, MS., 10 et seq.

³ "The word 'seepage' is applied particularly to the water which begins to appear in spots below irrigation canals and cultivated fields, usually some months or even years after irrigation has been introduced, and which tends to convert the lowlands into marshes

12 *The Economic History of Irrigation in Utah.*

carrying off or diverting surface drainage or that of the subsoil. The head-works were insecure, ditches were frequently duplicated, and their lands were over-watered, because it was customary to turn the water on in the spring and not shut it off until the fall.

Early in the economic history of the Mormons the dominant church encouraged the practical application of the principle that the water right should be inseparable from the land.¹ This is to-day the real key to their industrial system. To the pioneer, water was not only the basis of wealth, but of human existence; the irrigation canal was the first and highest of public utilities. Naturally the ownership and administration of these canals was the first problem to be solved in forming an irrigation system. Monopolies of water in the interest of speculative holders were not tolerated; it was resolved that canals should be so constructed that no interest would ever be paid on water stocks or bonds.² A destitute people having no resources save the genius of their leader and the labor of their own hands, resolved to associate and organize their efforts to bring the water on as the people of Holland were compelled to cooperate to keep the water out.

Head-works and dams were constructed by co-operative labor organized and controlled by church authority. That labor should constitute the basis of stock in every canal was the governing principle of Utah colonization.³ No money was necessary and but little was in circulation. Each farmer became an owner of shares in the canals constructed, in proportion to the diligence of himself and his sons and

and gives rise to springs, which in turn may be employed in watering the fields." Water Supply and Irrigation Papers of the U. S. Geological Survey, No. 7, 11.

¹ Snow's Voice of Joseph, 16; Utah Early. Pioneers, MS., 1848, 34-35.

² "No expense was incurred by the farmer save the labor of his own hands." Wilford Woodruff, My Twenty Acre Farm, 4.

³ "Real capital consists in knowledge and physical strength. If we know how to apply our labor, it will produce all we ask for." Brigham Young in Journal of Discourses, i, 203.

the strength of his oxen or mules. The lumberman felled the trees of the native mountain forests and furnished materials for flumes, gates and bridges; while the skilled mason mixed the mortar and stones for walling the cuts and fills, and assisted in building aqueducts to carry water to his home and farm the remainder of his days. Inasmuch as a monopoly in water was dreaded by the pioneer, it was provided that all irrigation works should be constructed at public expense and transferred to the farmers dwelling in the particular districts watered. Canals thus constructed by the combined labor of the farmers required no high engineering skill. The virtue of this system of co-operation lay in the fact that it enabled the people to obtain water without delay and without going into debt; the evil, the fact that it involved the building of many little ditches which will some day necessitate a complete reconstruction of canal systems. For when an undertaking was too great for an individual to complete, labor associations were formed to do the work under the co-operative system, and hundreds of small creeks from which water could cheaply be diverted were thereby constructed by the association for the benefit of the individual.

This method of associated industry which the pioneers learned from the necessity of co-operating in the building of canals and in tilling the soil, without which they could not have produced the first potato or the first ear of corn, was carried throughout their entire economic structure.¹ In every settlement the principle of co-operation was exemplified in the organization of mercantile corporations and banks. This was probably due to the fact that the

¹ "Co-operation is as much a cardinal and essential doctrine of the Mormon Church as baptism for the remission of sins. . . . Early in his day, Joseph Smith attempted to found a Communistic Church—not after the order of the French Communists and skeptics, but such a communistic Church or social and religious brotherhood as the great English Socialist believed Jesus and His Apostles to have established on the earth as the pattern of things in the heavens." Tullidge, *Quarterly Magazine*, i, 364.

14 *The Economic History of Irrigation in Utah.*

band of Mormons who settled Salt Lake Valley contained no rich men and represented no considerable capital collectively. They might live independently on the soil, but their large industrial and mercantile enterprises necessitated the use of capital and employees. When a store or woollen mill or bank was to be started the subscription list was thrown wide open to everybody. As all worked for themselves and received the full fruits of their labor, all were able to take a little stock in these enterprises. Generally they paid in cash or tithing-house scrip,¹ although sometimes in produce and not unfrequently in labor.² Thus, step by step, capital was secured for industry, and the business represented not an individual proprietor, nor a syndicate composed of a few, but a multitude of shareholders.

The village community was made the unit in the formation of the Mormon land system. Forts, erected for protection against Indian depredation,³ were the nuclei around which the crude log cabins were built. When the Indians were finally driven away, and it became possible to erect dwelling houses, town plats were laid out and were drawn by lot.⁴ As early as the twenty-seventh of July, 1847, the Council, composed of the president and twelve apostles, decided to build the city. According to a systematic plan it was agreed by the Council that the sites of all the Saints'

¹ Tithing-house scrip was currency whose legal tender power resided in an order on the tithing-house for so many dollars or cents' worth of tithing-house goods. The institution of tithing originated in 1831 in the three revelations of Joseph Smith, each containing a clause requiring money and other property to be set apart for general use in the Church. In its most universal application, tithing consists of one-tenth of all any one possessed at the commencement of the building of the Temple, and one-tenth part of the increase from that time until his death, whether it was money or whatever he was blessed with. At this early period very little money was in circulation, trade being mostly in the form of barter; hence, most of the contributions were paid in produce.

² Contributor, 332.

³ Wells' Narrative, MS., 60.

⁴ "That all might be satisfied, the lots were distributed by ballot or casting lots, as Israel did of old." Bancroft, *History of Utah*, 286.

cities should be laid out in blocks or squares of ten acres, and in lots of an acre and a quarter; the streets to be eight rods wide, with sidewalks of twenty feet.

The ideal to be attained in the distribution of property was an equitable division of land values. Accordingly, four classes of lots were provided. In the centre of the city the lots were one and one-quarter acres in size. The second tier was composed of five-acre lots, the third of ten-acre lots, and the fourth of twenty-acre lots.¹ It was designed that every man should be a landowner and no one a tenant, but that the amount of land assigned to each should vary with its value as determined by location, and vary also with the calling of its owner. The smaller lots were assigned to professional and business men. Mechanics and artisans took the five-acre lots, and possession of that amount of irrigated land made them quite secure in their living, even when their time was not fully employed in their trades.² The ten, twenty and sixty-acre tracts were given to farmers in proportion to the size of their families, and were to be held in individual ownership.

¹ "President Young waved his hand and said: 'Here is the forty acres for the Temple. The city can be laid out perfectly square, north and south, east and west.' It was then moved and carried that the Temple Lot contain forty acres on the ground where we stood. It was also moved and carried that the city be laid out 10 x 20 rods each, exclusive of the streets, and into blocks of eight lots, being ten acres in each block, and one and a quarter in each lot. It was further moved and carried that each street be laid out eight rods wide, and that there be a sidewalk on each side twenty feet wide, and that each house be built in the centre of the lot twenty feet from the front, that there might be uniformity throughout the city. It was also moved and carried that there be four public squares of ten acres each, to be laid out in various parts of the city for public grounds." Wilford Woodruff, *Historical Record of the Pioneers*, 81.

² "Mechanics were each expected to draw at least five acres, and if their families were large enough, they could draw ten acres. It was not a law, but a regulation. These regulations were adopted so that no man should monopolize land. Every man in the community could have a sufficient quantity to enable him to raise what he wanted, but could have no land for speculation." George Q. Cannon, *The Mormon Land System*, 5.

16 *The Economic History of Irrigation in Utah.*

There was also an arrangement by which some of the outlying lands were to be held in common as well as in fee simple,¹ so that the cities of the Mormons were similar to the English communities. If there was native meadow land within range it was treated as the old folk-land; the shares of pasturage or hay being apportioned according to the number of actual settlers desiring the same. The range of public domain became the property of the entire colony, and was used for horses, cattle and sheep, as agreed upon by the majority of those interested.

During the year 1847 the influx of settlers assumed such large proportions² that it was deemed necessary to lay out sites for farm villages. The principle adopted in this system of colonization was to enclose a half-mile square, to be selected in the midst of a tract of five or six thousand acres to be irrigated.³ This half-mile square was usually located near the centre of the valley and near the mountain stream, from which water was diverted into canals on each side at a sufficient elevation to command the irrigable lands. The half a square mile was laid out in blocks of four acres, each block being subdivided into lots of an acre each. On these lots the farmers were to have their homes, while their farms were located on the outlying lands, which were divided into lots ranging from two acres up to twenty acres. Under this system the advantages of town life were blended to a considerable degree with the charms

¹ "When the Mormons first arrived they did not quarrel for the best land, but cultivated a whole district in common." Olshausen's *Mormonen*, 166-7.

² "Before the expiration of the year, 2393 white persons and 24 negroes had immigrated." *Utah Early Records*, MS., 41.

³ Salt Lake City was the model of the village community system. All the farms around this city were enclosed in one common fence, constituting what was called the "Big Field." "This field amounted to five thousand one hundred and fifty-three acres." *Utah Early Records*, MS., 20-21.

⁴ "It is true that the settlements or towns are located in positions where they can obtain water for irrigation." Remarks of George A. Smith on Prosperity of Southern Utah, in *Journal of Discourses*, 381.

of rural existence. Farm life under such conditions involved no isolation.

The fact that the original town sites were located on some living mountain stream,¹ having a sufficient flow of water to supply the demands for irrigation in the fields, and for culinary purposes in the settlement, had an important effect on the customary law regulating the control and distribution of water. For before the system of priority of rights was introduced, the city and town authorities, by common consent, assumed the powers of controlling and distributing the water.² When no regularly constituted council existed the entire community constituted a committee or directory, and employed a watermaster on an annual salary, or with the understanding that the distributor should be paid by levying an assessment on the ratio of acreage under cultivation. The duties of the watermaster consisted in equitably distributing the water among the users, deciding disputes as to the proportionate share of each user, and levying such taxes as were necessary to keep the canals and dams in repair.

The rate of taxation was determined by the city council, and was assessed on each city lot and acre to be irrigated. This tax could be paid either in labor or in material necessary to repair the canals and dams. One dollar and fifty cents and the cash market value of the materials were

¹ It is invariably true that the colonies were formed on the banks of streams. A peculiar fact to be noted in this connection is that in the survey of any town or city in Utah the principal points or "stakes" from which the lines were run were water-sources. For instance, the tract in which Ogden is enclosed is described as "commencing at the mouth of Weber Canyon, following the base of the mountain north to the Hot Springs, thence westward to the Great Salt Lake, along the southern shore of the lake to a point opposite Weber Canyon, and thence to the point of beginning." Stanford, Ogden City, MS., 1.

² At the very first Conference of the Church, held August 22, 1847, a watermaster was appointed. "President Young moved that Edson Whipple receive an appointment to attend to the distribution of water over the ploughed lands." Historical Record of the Pioneers, MS., 99.

18 *The Economic History of Irrigation in Utah.*

allowed in lieu of money payments. If any person failed to pay his water tax in labor or materials within three days from the time called for by the watermaster, the latter was authorized to make the necessary repairs and collect the tax by law. That the institution of watermaster has survived is seen in the case of the municipalities and chartered cities of Utah to-day. These municipalities furnish an exception to the law of priority of right, in that they have built and own systems of irrigation which are held in communal rather than allodial ownership.¹ This gives them certain advantages over associations that have an existence in other States and Territories where irrigation is practiced, inasmuch as they can levy taxes for the use of water and collect them through the ordinary legal machinery.

Brigham Young, in framing this co-operative system of irrigation, taught his followers that if agriculture in the arid region was to be successful there must be a small farm unit devoted to diversified production, intensively cultivated and faithfully fertilized.² That no man should own more land than he could cultivate to its highest point by his own and his family's labor was one of the ecclesiastical dogmas of

¹ Of the sixteen canals in Weber County to-day, fifteen are owned by towns. Logan City owns 26 $\frac{2}{3}$ per cent of the paid-up capital stock of the two largest co-operative canals in Cache County, viz.: the Logan, Hyde Park and Smithfield Canal, irrigating 3123 acres, and the Logan and Richmond Canal, irrigating 3275 acres. In Utah County nearly all the larger canals belong to incorporated cities. All landowners under the city ditches have a right to the water by paying fifty cents per acre. The public ownership of irrigation canals, ditches and flumes in the early settlement of Utah is probably the explanation of their exemption to-day from the burden of the real property tax. Although irrigated lands are taxed, the law specially exempts irrigation canals. (Cf. Sec. 2503, Revised Statutes of Utah, 1898.)

² "The immense labour of irrigating alone, to say nothing of the scarcity of water that exists in nearly every settlement during mid-summer, at the very time the water is most needed, should be an incentive to the farmer to exert himself by more thorough culture and a liberal application of every species of fertilization, to raise his sustenance from a smaller quantity of land." Sermon delivered by Brigham Young, December 18, 1848. Cf. *Journal of Discourses*, 277.

the Mormon Church. President Wilford Woodruff says that each man's land, both in the country and in the city, was measured out to him, and that no one could receive more than he could industriously take care of. So while the city lots were generous in size—an acre and a quarter—on which both an orchard and a garden could be grown, the farms were small. The original farming plat was subdivided into five-acre tracts, to be allotted according to the size of the family. In the early fifties a bachelor received only ten acres, a married man with one wife and a small family twenty to thirty acres, while a polygamist with several grown-up sons was favored with a sixty-acre tract.¹ City lots were distributed on even a more exclusive basis. Every family, every man the head of a family, was entitled to one lot and no more. George Q. Cannon, the prime minister of the Mormon Church, relates an amusing incident in this connection. He applied for a city lot and, being a single man, was told that he could not have one. Whereupon he said, "I resolved to make up for my single condition in the future."²

Closely related, both historically and logically, to this principle of occupied land in small holdings was the belief that farm products should be diversified to the last degree.³ Brigham Young thought the home market of more value than the foreign market, and before all other home markets he aimed to supply the one at the producer's own fireside. He argued that no one should think of a surplus crop for export until the consumers at the farm gate had been supplied, that the farmer should feed his hunger by the products of his own labor and the fruits of his own soil.⁴

¹ Samuel Fortier, *Irrigated Utah and her Needs*. Cf. Report of Utah Irrigation Commission, 1894, 38.

² George Q. Cannon, Address before the Kansas Irrigation Association, 1895, cf. *Proceedings* of, 21.

³ "Let us learn to analyze the soil and know its component parts, then we will understand whether it is best adapted to the growth of vegetables, or wheat or other kinds of grain." Sermon delivered by Daniel H. Wells, March 22, 1848, cf. *Journal of Discourses*, 301.

⁴ "Let us heed the counsel given about storing up provisions,

20 *The Economic History of Irrigation in Utah.*

This simple economic system that man's capital should be his own labor, that the farm unit should be so small as to yield the highest results of intensive cultivation, that each family should produce what it consumed and reserve the surplus for the home market to absorb—this system possessing the certainty of a living and the reasonable hope of a competence, was fashioned in rough outlines by the pioneers of 1847.

The spring of 1848 saw flourishing fields in this new land of Deseret, containing a good variety of vegetables and grain.¹ Crudely constructed ditches carried the canyon waters to the fields, and the Mormons were preparing to partake of their first harvest in the arid region. But now there came a plague as destructive as it was unexpected. It was a plague of crickets, darkening the earth in their passage and devouring everything that was planted. "Think of the precarious condition of the Saints," says Mr. Cannon, "the food they brought with them almost exhausted, their grain and other seeds all planted, they themselves twelve hundred miles from a settlement or place where they could get food on the east and eight hundred miles from California, and the crickets eating up every green thing, and every day destroying their sole means of subsistence for the months and winter ahead."² The settlers were saved from famine by sea-gulls, which settled upon the fields by hundreds and thousands and devoured the insects.³

Although the harvests were partially destroyed by the crickets, the yield was large enough to attest the practical

and, instead of freighting our food away to feed strangers, let us go to work and build good substantial granaries and fill them with breadstuff, until every man and woman has enough to last for seven years." Sermon delivered by George A. Smith, October 9, 1847.

¹ "Wheat harvest good. Corn crop good. . . . Had a surplus of breadstuff this year." Hist. Brigham Young, MS., August 1, 1848, 52.

² Juvenile Institutes, ix, No. 2, 22.

³ Jennings, Material Progress, MS., 6-7.

benefits of even a crude system of irrigation and furnished numerous opportunities for a comparison of dry-farmed and irrigated lands. The wheat crop was so lucrative at the price of \$2 a bushel that a home population of 1800 was fed and there was a surplus of breadstuffs. Pumpkins, melons and corn yielded good returns. Oats yielded sixty bushels to one planted.¹ Parley P. Pratt writes: "I had a good harvest of wheat and rye without irrigation, but those who irrigated had double the quantity."²

Like the thankful Israelites, the Mormons resolved to celebrate the Feast of their First Harvest and dedicate Utah as the "Cradle of American Irrigation." The same author writes of this irrigation jubilee: "Large sheaves of wheat, rye, barley, oats and other productions were hoisted on poles for public exhibition, and there was prayer and thanksgiving, congratulations, songs, speeches, music, dancing, smiling faces and merry hearts. In short, it was a great day with the people of these valleys, and long to be remembered by those who had suffered and waited anxiously for the results of a first effort to redeem the interior desert of America."³

¹ Hist. Brigham Young, MS., 1848, 52.

² Pratt's Autobiography, MS., 405.

³ Ibid., 406.

CHAPTER II.

ECONOMIC DEVELOPMENT UNDER THE CO-OPERATIVE SYSTEM (1848-62).

The Mormons were now firmly established as a class of landed proprietors. Speculative wealth having been created by a rise in land values, they were eager to further develop the economies of their industrial system. An immigration of 1891 souls in October, 1848, increased the demand for food to such an extent that all supplies were reserved for home consumption.¹ The committee on bread-stuffs reported on the 8th of February that there was only $\frac{7.8}{100}$ lb. per capita for the next five months. Corn was selling at from \$2 to \$3 per bushel, wheat ranged from \$4 to \$5, and a bushel of potatoes yielded the producer from \$6 to \$20.² High prices and limited supplies served to stimulate production, and believing that the irrigation ditch and unincumbered land would increase their talents tenfold, they refused to eat the potatoes that had been raised the preceding year, but saved them for seed. A proclamation was issued by Brigham Young that when cities are built and land is chosen "every man is to help build a pole, a ditch and stone fence around the 'big field' in proportion to the land he draws; also a canal on each side for purposes of irrigation."³

Before the harvest of 1849 was reached, most of the settlers lived on raw hides, which were boiled and converted into a gelatinous soup, but the harvest was so bountiful that for six years afterwards no one wanted bread in the city of Salt Lake. Brigham Young, con-

¹ Utah Early Records, MS., 33. Richards' Narratives, MS., 38.

² Frontier Guardian, May 30, 1849.

³ History of Brigham Young, MS., 1849, 55.

vinced that he had found in irrigation the basis of the most certain worldly prosperity, stated that the necessities of life would be supplied to the Saints in the immediate future as cheaply as they could be in the city of St. Louis.¹

Heretofore, directed by ecclesiastical authority, the pioneers had not quarreled for the best lands, but cultivated a whole district in common, dividing the harvest according to work done, seed supplied, and need of family. The church authorities had decided that land could not be sold for a greater sum than was included in the first cost plus the cost of improvements, inasmuch as the land belonged to God and was merely held in use by the holder.²

Brigham Young fiercely and successfully opposed farming which sprang from an instinct of speculation rather than from the instinct of industrialism, and always insisted that the unearned increment embodied in a rise in land values should be equitably distributed among the whole body of farmers. But so beneficial had been the results of the system of irrigation in extending colonization and encouraging improvement, so prevalent was the anticipation of a rise in the value of the irrigated farms as the immediate result of the harvest of 1849, that the irrigators began to speculate on their land. There was a desire among some to become irrigation overlords, to acquire estates on a scale as large as the baronial feudatories, to monopolize the bench lands and those located along creeks or rivers. They reasoned that if one-quarter section was a good thing, two-quarter sections would be just twice as good.

Water and land are so closely wedded to each other in a system of irrigation that a monopoly of land almost invariably means a monopoly of water. To monopolize water in an arid country is to so limit its supply and artificially increase its demand that this bounty of nature will be beyond the reach of a farmer having no capital save his labor. Water is the irrigator's fixed capital, and if the tribute in the form of

¹ Smoot, *Mormon Wife*, MS., 5-6.

² Olshausen, *Mormonen*, 166.

24 *The Economic History of Irrigation in Utah.*

an annual water rental eats up the interest which could be secured from the investment of this capital, irrigation becomes an instrument of oppression. Brigham Young intended that the irrigator should own his own land and construct his own canal; and although his system of small farm units and co-operative labor may be open to the objection that it means a multiplicity of canals taken from natural streams at a greatly increased cost of construction and maintenance, it is certainly a more enduring irrigation economy than one which encourages speculation and enables the lender of a mortgage to reap the appreciation accruing from the enhanced value of land and water. By suppressing these secret attempts at speculation in 1849, the church authorities established a precedent that has become as binding as an unwritten law. As a result, the people of Utah are secure in their control of natural monopolies and are firmly established in their ownership of unmortgaged land.

But if the bounteous harvest of 1849 had the evil effect of inciting speculation, it had the equally beneficial effect of stimulating commerce and of introducing improved media of exchange into Utah's monetary system. The older settlers, who by priority of colonization had received the best allotment of land and water and who had accumulated a great deal of seed from their crops of 1847 and 1848, had a large surplus of breadstuffs over and above their home consumption. On the other hand, the newer settlers who had arrived in Deseret the preceding October had not had sufficient time in which to build their dwelling houses, construct ditches and irrigate their crops; but many of them were rich in cattle, swine, poultry and gold dust, and were willing to exchange these for the breadstuffs.¹ Division of labor, represented in concrete form by variety in the products of labor, had enlarged the market; and by a natural economic principle the higgling and bargaining of this enlarged market leveled all inequalities in the business of

¹ Richards' Narrative, MS., 38. Salt Lake Contributor, xi, 209.

every-day life. A larger volume of exchange required a larger volume of currency and standards of value possessing more stability than the blankets, grain and seeds that had heretofore been used.

Early in 1838 Joseph Smith claimed to have had a revelation from heaven commanding him to establish a bank that would swallow up all other banks. Accordingly the Kirtland Safety Society Banking Institution was established in Kirtland, Illinois, operating on a pretended capital of \$4,000,000, made up of real estate around the Temple.¹ The issues of this bank were of a wild-cat nature, the circulating medium had no basis of redemption and was worthless in the hands of the people.² Under such conditions it was not surprising that Joseph Smith should have had another revelation declaring that "although the Kirtland Bank was a pattern of all the banks of the United States, it would speedily break and break other banks with it."³ He made the prediction, however, that some day the Kirtland banknotes would be as good as gold, and this was literally fulfilled when in 1849 the Apostolic Council decreed that the Kirtland's banknotes be put into circulation for the accommodation of the people.⁴

Widening economies in irrigation farming demanded a still larger extension in the currency, so gold coins were struck, fifty-cent and one-dollar banknotes were issued, and even cattle and leather constituted stock for some of the financial enterprises. This currency, whether in gold or paper, was afterwards designated as "valley tan," a name first applied to leather tanned in the valley, and afterwards to other articles of home manufacture.⁵ An increased elas-

¹ Corroll, in Kidder's *Mormonism*, 126-127.

² Tucker's *Mormonism*, 154-155.

³ "The bubble burst, and many in the vicinity of Kirtland were among the sufferers." Remy's *Journey*, i, 504. Busch, *Geschichte der Mormonen*, 84.

⁴ Hist. Brigham Young, MS., January 6, 1849.

⁵ Taylor (*Reminiscences*, MS., 14-15) says that the term "Valleytan" was applied to crockery, medicines, whiskey, furniture, and even to gold coin made in Salt Lake City. It afterwards became synonymous with home-made goods.

26 *The Economic History of Irrigation in Utah.*

ticity and better stability in the circulating medium was thus stimulated by an increased production of farm commodities, which was itself the immediate result of diversified industry and the small irrigation unit.

As a result of the California gold-seeking expeditions in the fall of 1849, farm products advanced enormously in price, flour selling before the harvest in 1850 at \$1 per pound, and after the harvest at \$25 per cental.¹ Many of these emigrants were entirely destitute of provisions. However, their trains were loaded with valuable merchandise for which the owners expected to find a ready market on reaching their destination. Inasmuch as the San Francisco markets were overstocked, vessels having arrived at that port filled with eastern goods, the gold-seekers were willing to exchange their outfits and trading goods for whatever they could get. Farming implements, which meant improved processes of production to the settlers, were obtained in exchange for pack animals and provisions.² With this additional incentive to effort before them, the pioneers were enjoined to labor as a duty as sacred as prayer.³ Grist mills were running to their full capacity; sugar, which could be readily sold at the rate of three pounds for \$2, was manufactured from beets.⁴ It was with difficulty, however, that the gold fever which had infected the Saints was held in check. Brigham Young and other church authorities feared that this spirit of adventure would materially retard, if not put an end to, the colonization of the Great Basin, as well as corrupt the morals of the community. In a general epistle of the first presidency and

¹ Utah Early Records, MS., 112. Contributor, MS., 240.

² "A single horse or a mule, with a small stock of provisions, were sometimes accepted by the emigrants as an equivalent for Yankee wagons, spades and shovels that had cost the owners thousands of dollars." *Frontier Guardian*, September 18, 1850.

³ "The Saints have a good capital of bone, muscle, and sinews on hand. When this is not employed for the benefit of the kingdom of God, the capital which God has given to us as individuals and as a people is wasted." *Journal of Discourses*, i, 172.

⁴ Utah Early Records, MS., 100.

apostles in the fall of 1849, the attitude of the church towards the proposed migration to California and the opening of the Utah mines was thus clearly set forth: "The true use of gold is for paving streets, covering houses and making culinary dishes, and when the Saints shall have preached the gospel, raised grain and built up cities enough the Lord will open the way for a supply of gold to the perfect satisfaction of His people."¹ In an address delivered at the Tabernacle, Brigham thus forcibly expressed himself: "I hope the gold mines will be no nearer than 800 miles. . . . If you elders of Israel want to go to the gold mines, go and be damned. If you go I would not give a picayune to keep you from damnation."² The migration was stayed and the colonization of the valley began anew.

It is a significant tribute to the value placed upon water by the pioneers of arid America that in the settlement and occupation of the country, cities and towns were invariably located on streams where the maximum supply of water could be obtained.³ In the settlement of Salt Lake City the waters of the Big Cottonwood were diverted for purposes of irrigation and a field was sown with winter wheat before lots were assigned for building. The site of Ogden, to-day the railroad centre of the inter-mountain region, was laid out between the forks of the Ogden and Weber rivers, so that water from both streams might be used for irrigation.⁴ Provo, the third largest city in the State, is situated where timber and pasture are abundant and where the gradual fall of the Timpanogos affords excellent water-power.⁵ This system of colonization was pursued throughout the entire history of the growing commonwealth; good farming land, good range for stock and good water-power

¹ Frontier Guardian, December 26, 1849.

² History of Brigham Young, MS., 1849, 1002.

³ "Villages were located on the sites where there were farming and grazing lands of fair quality, and streams that could be easily diverted for purposes of irrigation." Utah Sketches, MS., 121.

⁴ Utah Early Records, MS., 20-21.

⁵ Richards' Narrative, MS., 66.

28 *The Economic History of Irrigation in Utah.*

were the inducements that attracted settlers and caused the village community to thrive.

As early as 1850 the beneficial results of this colonial organization had extended to every economic and social condition and made the lot of the people better in all respects. Education was fostered, and in April, 1850, a State university was established.¹ Flannels, linseys, jeans, pottery, and cutlery were manufactured and sold for more reasonable prices than were asked for eastern goods of an inferior quality.² The census report of 1850 shows that at that time there were 11,354 inhabitants of Salt Lake Valley; that 16,333 irrigated acres of land were under cultivation, on which 120,711 bushels of grain were raised.³ In addition to nearly 130,000 bushels of cereals, 45,000 bushels of potatoes were also raised, besides other vegetables, together with 40 lbs. of hops and 70 lbs. of tobacco.⁴ The value of live stock was estimated at \$546,698, and of farming utensils at \$84,288. Two years after this report was issued the assessed valuation of taxable property in this once arid region was \$1,160,883.30, an average per capita of more than \$400. The territorial revenue amounted to \$26,690.58, of which $\frac{9}{10}$ was paid in grain.⁵ The country was canvassed to ascertain how many inmates there would be for a poor-house. Only two were found and the Mormons concluded that it was not yet time for such an institution. The little band of 148 pioneers had augmented through the agency of an agricultural system which guaranteed that increased labor would be rewarded with an increased harvest, to 35,000 souls, spending for annual public improvements over

¹ "An appropriation of \$5000 per annum, for a period of 20 years, had been made for a State University in Salt Lake City, branches to be established throughout the territory." *Frontier Guardian*, MS., June 12, 1850.

² *Hist. Brigham Young*, MS., 1851, 26.

³ The returns were made under the direction of Brigham Young, who was appointed census agent. *Deseret News*, October 5th, 1850.

⁴ *Utah Sketches*, MS., *passim*.

⁵ *Hist. of Brigham Young*, MS., 1852, 2. Contributor, 332.

\$90,000.¹ Small farms, as originally planned under ecclesiastical direction, had taken away the bane of loneliness and fostered communal life.

So strong was the co-operative society of the Mormons, with its contented peasantry and its perfect village community organization, that a desire began to be felt that a civil government should be established for "the inhabitants of that portion of upper California lying east of the Sierra Nevada mountains."² The Constitutional Convention, which met on the fourth of March, 1849, was confronted with many difficulties. The vast extent of arid domain which was to be constituted a sovereign and independent State, contained little more than one-sixth of the number required for admission as a State. Yet so positive was the assurance that the marvellous results of the reclamation of an arid waste would encourage immigration that the organization of a provincial government was decided upon. The new State was christened "Deseret," as a tribute to Mormon industry, the name "Deseret" meaning honey-bee.³

Industry and unanimity characterized the efforts of the settlers, and their government was pre-eminently one of peace, prosperity and energy. Counties were created, which received the ecclesiastical name of "Stakes." The Mormon land polity assumed a more definite shape, and parties were formed to explore the southern part of the new State. San Pete valley, now the granary of Utah, was settled and its streams utilized for irrigation.⁴ Cedar and Jordan valleys were veritable beehives of enthusiastic irrigators.⁵

¹ Olshausen, *Mormonen*, 192. "Early in 1853 the *Deseret Almanac* places the number at 30,000, while in Orson Pratt's *Seer* it is given at 30,000 to 35,000."

² *Utah Early Records*, MS., 1849, 51.

³ The word *Deseret* is taken from the *Book of Mormon*. As it is written in the book of *Ether* of the people who came over the great water from the Old World to the New, "And they did also carry with them 'Deseret,' which, by interpretation, is a honey-bee."

⁴ *Journal of Discourses*, 381.

⁵ *Utah Sketches*, MS., 150. *Deseret News*, April 17, 1852.

30 *The Economic History of Irrigation in Utah.*

The period between 1850 and 1857, the date of the Utah war, was one of material prosperity and irrigation development. Applications were constantly made to the territorial Legislature for charters of incorporation for canals under process of construction. The Big Cottonwood Canal Company was incorporated in 1855,¹ and the appropriation of the Ogden Bench Canal Company was made the same year.² An act empowering the diversion of the waters of the Provo river for purposes of irrigation passed the territorial Legislature as early as 1853. The discovery of gold in California and the subsequent discovery of rich minerals in Nevada on the west and Idaho and Montana on the north, afforded the people of Utah a ready market and high prices for the products of their labor. Tithing-house receipts increased, and an instance is cited where 6000 head of milch cows and sheep and 34,000 bushels of wheat were loaned to the poor out of the church treasury without interest.³ The Governor's message in 1853 showed an expenditure of \$12,301 for public improvements, on a basis of an assessment of only one per cent; warrants amounting to \$14,834 had been issued and redeemed to meet incidental expenses, and there was still remaining in the treasury \$4554.⁴

The surplus of farm profits over home consumption was so large at this time that the problem of transportation became as important to the irrigator as the construction of canals. It was quickly realized that the system of intercommunication by wagon roads should be superseded by railroads if Utah's farms were to supply foreign markets.

¹ Utah Legisl. Acts, 1855, 277-9. For progress of work cf. *Deseret News*, August 29, 1855, March 25, 1857.

² Under a territorial law which obviated the necessity of forming an incorporation, many of the companies simply filed a certificate of appropriation. Thus, some of the early canals are to-day simply legal fictions.

³ Circulars from the Twelve Apostles, Salt Lake City, April 16, 1880.

⁴ Utah Legislative Journal, 134. *Deseret News*, December 15, 1853.

Accordingly, in 1854, a memorial was addressed to Congress by the territorial Legislature urging the construction of an overland railroad.¹ This memorial, which was not acted upon until 1868, expressed a willingness on the part of the Mormons to subscribe money, land and labor to such an enterprise. Manufactures increased in the seven years following 1850 from 14 establishments, representing \$44,400 of capital and \$291,233 of products, to 48 establishments, representing \$443,356 of capital and \$900,153 of products.² The chief article manufactured was flour. It is estimated that the irrigated farm supplied three-fourths of the raw material from which manufacturing establishments derived their support.³ In addition to the expenses incurred for internal improvements and the maintenance of the Territorial Government, \$300,000 was expended in quelling Indian outbreaks, and a loss of \$2,500,000 was sustained by crickets, locusts and grasshoppers destroying a portion of the crops.⁴ The brunt of these expenses fell on the irrigator, inasmuch as manufactures were as yet in their infancy and could not afford to pay their pro rata share of assessment. Unsuccessful early experiments in making iron, sugar, paper, nails, leather, etc., had drained infant industries to the extent of \$6,000,000, and there was no economic resource left save the irrigator's harvest. Population increased from 40,000 in 1854 to 76,335 in 1856, and

¹ Tullidge, *Life of Brigham Young*, 213-14. Smith, *Rise, Progress and Travels*, 22.

² Bancroft, *Hist. Utah*, 733.

³ *Pacific Coast Directory*, 1867, 153. Hollister, *Resources and Attractions of Utah*, 56.

⁴ Estimates made by A. Milton Musser, *The Church Historian*, in 1895. The Mormon policy toward the Indians was that it was cheaper to feed than to fight them, and their relations with the Utes and Shoshones were most peaceable. But the Utahs, incited to pillage and warfare by their chief, Walker, an Indian who was a fluent linguist, excellent shot and magnetic leader, committed depredations which cost the pioneers over \$200,000. Governor's Message in *Utah Legisl. Journal*, 1853-54, 121-22. The Walker war, as it was called, was but the precursor of a long series of Indian depredations.

32 *The Economic History of Irrigation in Utah.*

with it there increased the demand for farm products for purposes of home consumption. During that year a society was incorporated called the "Deseret Agricultural and Manufacturing Society," with a view of developing the most scientific methods of irrigation.¹

With the exception of Indian depredations the Mormons had now enjoyed the ten years of peace which Brigham Young had so ardently desired on entering the Salt Lake Valley.² However, they were soon to be afflicted with a period of war which meant a depletion of their treasury, a lethargy in industry, a lull in irrigation prosperity. In 1856 the long and bitter feud between Mormons and Gentiles began, a feud which in the following year attained the proportions of an open war. Whatever may have been the cause of this animus rending Zion in twain—whether the fact that polygamy and theocracy were in hopeless opposition to the American ideal; or, as the Mormons claim, that the rights of a self-respecting local government were subverted by a dissolute and iniquitous federal judiciary—it is admitted on all hands that the exchange of the irrigator's flume and canal for munitions of war boded no good for the territory's material prosperity and social happiness.

But the struggle which terminated July, 1858, with mutual concessions from the Federal government and the Mormons, was an unimpeachable witness to the success of an industrial policy which enabled a people numbering less than 70,000 to liquidate a war indebtedness of over \$2,000,000.³ So plenteously had their canals and irrigated lands stored their granaries and barns, that isolated and friendless they offered a resistance costing a powerful government \$15,000,000.⁴

¹ Utah Legisl. Acts (ed. 1866), 111.

² "Give us ten years of peace, and we will ask no odds of the United States." Hist. Brigham Young, MS., 1847, 50.

³ Estimate of A. Milton Musser, Church Historian, 1895.

⁴ "The Utah War was an ill-advised measure on the part of the U. S. Government. It cost several hundred lives, and at least \$15,000,000, and accomplished nothing save that it exposed the President to well deserved ridicule." Bancroft, Hist. Utah, xix, 538.



AN IRRIGATION FLUME.



BEAR RIVER CANAL, SHOWING SPILLWAY.



Immediately on the close of the war the irrigator dropped his gun and seized his spade, with the result that the census report of 1860 pictured Utah as the most prosperous of the territories. At that time the value of real and personal property in Utah was estimated at \$5,596,118, the value of improved farm lands at \$1,333,335, of farming implements at \$242,889, of live stock at \$1,516,707, and of manufactures at \$900,153.¹ It is worthy of note in this connection that up to date but one case of suicide had been reported, and the table of pauperism revealed but one person receiving support as a pauper, and only eight criminals. Wages were good, averaging \$2 per day for common laborers and \$35 per month for domestic servants. Merchants, the credit of whose customers was based on the co-operative canal and the intensive farm unit, were esteemed in eastern trade circles as among the shrewdest and the most successful in the land. However, comparatively few imported commodities were bought, because high freight rates made them inordinately dear.² That an agricultural policy providing shelter, raiment and three meals a day was beneficial at this time to a people, who would otherwise have been at the mercy of Pacific seaboard charges of \$50 per ton for wares consumed, is apparent.

Irrigation, as an economic factor in promoting industry, encouraging immigration and widening the market for the absorption of Utah goods, was more fully appreciated now than ever before. The Logan, Hyde Park and Thatcher Canal, the oldest canal in Cache county, was begun in the spring of 1860, and during that year it irrigated about 700 acres. In Weber county the Eden, Plain City and Slaterville canals were constructed about this time, and \$485,580

¹ Report of Territorial Statistician, 1860. Burton, City of the Saints, 329.

² From the list of prices current at the tithing office in 1860 we learn that cereals were rated in Salt Lake City at \$1.50 per bushel; butcher's meat at 3 to 12½c. per pound; while tea ranged in price from \$1.50 to \$3.50, and coffee from 40 to 60c. per pound, or at least fivefold their cost in the Atlantic States.

34 *The Economic History of Irrigation in Utah.*

were spent in constructing a canal for the purpose of bringing the waters of Utah Lake into Salt Lake county. By an act of 1862 the Jordan Irrigation Company was incorporated, with power to construct dams across the Jordan and divert its waters.¹ Although nominally capitalized, the shares in these canals were paid in either property or labor, and the produce of the land irrigated was divided according to the number of shares held.

¹ For description of these canals, cf. Tullidge's Magazine, i, 534-5; Stanford's Hist. Sketch of Weber Co., MS., 22; Pacific Coast Directory, 1867, 30-2.

CHAPTER III.

EARLY LEGISLATION (1862-67).

From 1806 to 1862 various land and Indian claims were settled by the issuance of indemnity scrip permitting the holder to locate land on the public domain. This tenure by "Indian title" had not been extinguished in Utah, the sections were not open to pre-emption, and therefore the Mormons found themselves merely in the condition of squatters.¹ They were ready to purchase, but the organic act forbade the primary disposition of the soil; and, despite their ability and eagerness to purchase, the Government still hesitated to make them its permanent owners.

A timely relief to the settlers came with the passage of the "Homestead law" of May 20, 1862. The question of reserving public lands from further grants to corporations and from sale, setting apart such lands for the benefit of settlers thereon, was agitated as early as 1852. Public sentiment as to the expediency of such an act was divided,

¹ Regarding the land titles of the Mormons, Lieut. Gunnison (Gunnison, *The Mormons*, 152) says: "They issue a right of occupancy from the State Registrar's office. This is contingent on the grant of the general government, of course, and forms one of the subjects upon which they may come into collision with the supreme authority. They will not, without protest, buy the land, and hope that grants will be made to actual settlers or the State, sufficient to cover their improvements. If not, the State will be obliged to buy and then confer the title already given."

Richard F. Burton (*Burton, City of the Saints*, x, 356) ten years later wrote upon the same subject as follows: "The Mormons have another complaint touching the tenure of their land. The U. S. have determined that the Indian title has not been extinguished. The Saints declare that no tribe of aborigines could prove a claim to the country, otherwise they were ready to purchase it in perpetuity and establish the usual reservation. The Federal Government has departed from its usual course."

because it meant an entire change in the then settled land policy. Instead of the public lands being disposed of for cash, they were to be given away to settlers who would occupy them for a term of years. The act as finally passed gave to every citizen the right of a homestead of one hundred and sixty acres minimum or eighty acres double minimum upon proof of five years' residence upon the land.¹

Most of the public land taken up in Utah in the early days was under homestead entries. A United States Land Office was established in Salt Lake City in 1869. 6388 homestead entries had been made in 1884, covering 844,159 acres; and in 1895 the acreage under this act amounted to 1,408,950.² This timely provision by the National Government for the disposition of the public domain insured permanency of title and marked a great stride forward in the history of irrigation in Utah.

The passage of the Utah District Law, February 20, 1865, marked a wonderful extension of the co-operative system.³ Heretofore, the principle of associated control was applied only in the construction of canals; through the agency of this law it was also applied in the distribution of water. The District Law is based upon two elementary principles. The

¹ To obtain a homestead, the applicant must swear that he is the head of a family, or over the age of twenty-one, a citizen, or declare his intention to become such; and the entry is to be made for his exclusive use and benefit, and for actual settlement and cultivation. When an applicant has made actual settlement upon the land he desires, he must make affidavit of the fact before the land Registrar, and pay fees amounting on 160 acres of minimum land to \$18, or an equal sum for 80 acres of double minimum, for which he gets a receipt; and after five years' occupation and cultivation of the land, he is entitled upon the proof of such cultivation to a patent or full title to the homestead. Cf. U. S. Rev. Stat., Secs. 2289-2317.

² First Triennial Report of Statistician, 1895, 6.

³ As Utah was the first commonwealth in the arid region to adopt the practice of irrigation, so it was the first to enact an irrigation District Law. The original law has existed almost intact with very few amendments to the present time. Cf. Cleson S. Kinney, *Irrigation, Water Rights, Appropriation of Waters*, 633. For provisions of the District Law, cf. *Comp. Laws Utah*, 1888, Secs. 2403-2427.

first is that which clothes all landowners "in a county or a part thereof" with power to organize themselves in an irrigation district. The second is that which clothes them with the power, when so organized, to supply themselves with the water at the bare cost of diverting it from its natural channels and applying it to lands. Thus the way is provided whereby all the people to be benefited may prosecute the work of appropriation and construction of the works, to the end that each acre of land requiring irrigation may have an ample supply. Under its provisions irrigation districts may be formed on petition to the County Court of a majority of the citizens of "any county or part thereof." All the landowners within the district are then entitled to the equal use of the water brought within the district, provided they pay their proportionate shares toward the construction and repair of the necessary irrigation work.

A district, when so organized, is invested with the same authority to prosecute its work as is a modern county. Indeed, the district officers are charged with duties corresponding to those of the officers of a county. A county has a board of supervisors vested with the management and control of its affairs; this board audits accounts, determines what work shall be done, prosecutes and defends suits in which the county is a party, acquires by purchase or expropriation rights of way and sites for public buildings, and in all particulars dispatches the business of a county. Likewise an irrigation district has a board of trustees, consisting of not more than 13 nor less than 3 members, elected by a majority vote of the citizens of the district in a mass-meeting. The power of the board is complete to the accomplishment of the end that a complete system of irrigation may be furnished the district. They have the power to conduct and manage the business of the district, make and execute all necessary contracts, employ and appoint such agents as may be required and prescribe their duties, establish equitable by-laws, rules and regulations

38 *The Economic History of Irrigation in Utah.*

for the distribution and use of water among the owners of land within the district, and, in general, to perform such acts as "are necessary to carry into effect the objects of the people." Like the officers of a corporate organization, they can sue and be sued, and can acquire either by purchase or expropriation all land, waters and other property necessary for the construction of any proposed works.

In addition to these general powers, the trustees have such special powers as are incident to these. One of the most important of these special functions is the power to raise money to carry out the plans embodied in the act. This is accomplished in the following manner. As soon after the district is organized as is practicable, the board of trustees estimates the amount of money to be raised for the purpose of constructing all canals and acquiring the necessary property and rights therefor. When the board arrives at a conclusion as to how much money is required to complete the work, they call a meeting of the landowners of the district and present a copy of their report. At this meeting the landowners vote "yes" or "no" upon the questions whether they will mutually agree to pay an acreage tax to meet the construction expenses,¹ and

¹ In this respect the Utah District Law is superior to the Wright District Law of California, which is usually taken as the model of district organization. Under the operation of the Wright Law the necessary district funds are raised by bond sales, taxes being levied on all property, real and personal, within the district to redeem the principal and interest on the bonds; while, under the Utah District Law, the necessary funds are raised directly by an acreage tax. If district bonds could find ready purchasers, the immediate burden upon the landowners would be lighter than if a direct tax were levied, but California experience has shown that district securities are not easily sold and that it is frequently necessary to trade them off at a heavy discount. The only criticism to be urged against the technique of the Utah District Law is the fact that it levies an acreage tax on *all* the land within the district and does not discriminate between irrigated and waste lands. This indiscriminate charge is beneficial in so far as it compels the taxpayer to reclaim his waste land merely as a matter of economy; but it violates the fundamental law governing the distribution of taxation; namely, that taxes should be levied in proportion to ability to pay.

also whether they approve the action of the former mass-meeting in the election of trustees. If there is a two-thirds vote in favor of the acreage tax it becomes the law of the district. The tax when collected is paid over to the treasurer of the district on his order, but only one-half of the tax voted is collected at one time, the remainder as the work progresses. If the original estimates of the trustees prove too small, additional acreage taxes are assessed until the necessary amount is secured.

The principal officers of the district, besides the board of trustees, are the treasurer and assessor, who are elected by a majority vote of the landholders, and are required to file official bonds with the county clerk for the faithful performance of duty. In subsequent annual elections held to determine the rate of taxation, the unit of suffrage is the acre and not the citizen—one acre entitling its owner to one vote. The tax voted is a lien on all water rights until paid, but is not a lien upon the land. "Property" or money in the hands of an irrigation district is exempt from city, county and territorial taxes. The word "property" has been held by the courts to include only the ditches, canals and flumes owned and used by individuals or corporations for irrigating lands; so, under this construction, the irrigated lands contribute their pro rata share to the general property tax. In the power of raising revenue, as in the case of the general powers conferred upon its officers, the Utah irrigation district bears a striking resemblance to the county. The assessor and treasurer perform precisely the same functions as are performed by the county assessor and treasurer for the county.

The District Law, so far as it relates to the levy and collection of assessments, and the custody and disbursement of money when collected, is substantially the same as the provisions of the political code relating to the revenue powers of a county. When the county needs a court-house, public bridge, jail or highway, the board of supervisors is authorized to call into exercise the functions of the county

to that end and the want is supplied. When the irrigation district needs a canal, dam and other appurtenances to an irrigation system, the board of trustees, by the exercise of similar functions, supply the want.¹ The District Law of Utah is, in short, local self-government for the community requiring it, whereby all the lands may, by the exercise of the ordinary governmental functions,² be supplied with sufficient water at the bare necessary cost.

The irrigation district also bears a striking analogy to a municipal corporation. The oldest and one of the most important quasi-private industries undertaken by the city in its capacity as a juristic corporation has been the control of the water supply for domestic purposes. While the ownership of water-works by municipalities has not yielded a satisfactory revenue, it has been beneficial in so far as it has insured a better regulation of sanitation and prevented a monopoly of water on the part of its holders. The difference, and the only difference, between the older municipal corporation and the later irrigation district is that the duties of the former were of wider scope, embracing sanitary and the more ordinary forms of police organization; while the irrigation district has but the one object, namely, the furnishing of sufficient water for the irrigation of the land comprised within it.

There are to-day forty-one irrigation districts in Utah, located principally in the northern counties of Cache, Salt Lake, Utah and Weber, representing an area of about 70,000 acres. However, it is doubtful whether the system can be extended beyond these counties, because the two natural conditions on which co-operative organization de-

¹ This striking similarity between the irrigation district and the county must have been realized by the framers of the District Law, for, by a special provision, the selectmen of the courts were made ex-officio water commissioners.

² The constitutionality of the district system was recently sustained by the U. S. Supreme Court on the general principle that county and municipal divisions are not the only taxing units into which a legislature may apportion a State. Cf. *Central Irrigation District vs. La Sappe* (Superior Court, California), 39 Pac. Rep., 902.

pend—population and a common source of water supply—are non-existent in other parts of the State.

An increase in population of over twenty thousand within the seven years following 1860 presaged the enactment of laws regulating water rights by the territorial legislature. Every year the area of land for which water was needed had been constantly increasing, and the available supply of water had been constantly diminishing. Colonization and cultivation had extended so far that the point had been reached where the water would not serve all the land under cultivation. Accordingly, acts were passed by the territorial legislatures of 1864, 1865, 1866 regulating the distribution of water and placing it within the control of the irrigators themselves.¹ The principle was established that those farmers who first made use of the water should ever afterwards be entitled to sufficient water to irrigate the amount of land originally cultivated by them, and that later comers, whenever scarcity occurred, should not take the water until those enjoying prior rights had satisfied their needs, the latest comers being the first to be deprived, and those settling before them losing their water supply in succession as it became less and less. For convenience the rights were not held in the exact order of settlement, but were divided into classes, all the individuals of one class or group sharing the water according to their respective claims.² This system of vested rights was known as the "priority of right system," and embraced three distinct classes—primary, secondary and tertiary.

Primary rights were acknowledged to have vested and accrued: (1) Whenever any person had taken, diverted and used any of the unappropriated water of any natural stream or other natural source of supply; (2) whenever any person or persons had enjoyed the open, peaceable, uninterrupted and continuous use of water for a period of seven years.

Secondary rights were acknowledged to have vested and accrued: (1) Whenever the whole of the water of any stream,

¹ Utah Compiled Laws, 879. Wheeler's Surveys, 1872, 28-33.

42 *The Economic History of Irrigation in Utah.*

watercourse, etc., had been diverted and used by prior appropriators for a part or parts of each year only, and other persons had subsequently appropriated any part or the whole of such water during any other part of such year, the latter person had a secondary right; (2) whenever the average seven years' flow of water had been used by a prior appropriator, and there was an unusual increase of water exceeding seven years' average flow, other persons appropriating and using such increase were deemed to have acquired a secondary right.¹

Tertiary rights only accrued when farmers having primary and secondary rights did not use or claim all the water. These third rights, when there was a scarcity of water, shut off the entire stream; while the first and second rights usually took the entire stream.² It was possible for an irrigator having prior rights to also have secondary rights, and even tertiary rights, to the water for lands not covered by his first rights, and thus in times of scarcity he did not lose all his water, but was able to mature a small portion of his crop. In order that this monopoly might not be abused, it was provided that a continuous neglect to keep in repair the means of diverting or conveying water, or a continuous failure to use any right to water for a period of seven years, was an abandonment of such right.³

These legal provisions regulating the distribution of water in Utah are in striking contrast to the customs established in other parts of the arid region, where the water is either under state control or in the hands of water trusts. Although this method practically gave a monopoly to those who enjoyed prior rights, it was decidedly the most economical and satisfactory one that could have been devised to insure the best results under a territorial form of government. To have placed the control and distribution of water

¹ Compiled Laws of Utah, 1888, Sec. 2781.

² Statement of the Probate Judge of Salt Lake County before the Special Committee on Irrigation and Reclamation of Arid Lands. 1890. 44. This is an unwritten law.

³ Compiled Laws of Utah, 1888, Sec. 2783.

within the jurisdiction of a territorial board of control, composed of federal officials poorly acquainted with the needs of the irrigators and the uses of water, would have encouraged wasteful methods in its diversion and application.¹ To have surrendered the management of water to great canal transportation companies would have encouraged the modern economic iniquity of a high water rental and compelled the irrigator to reclaim his land at just such a price as private enterprise chose to put upon it.

That the monopoly enjoyed by prior appropriators was to some extent tempered with justice is seen when it is considered that if all the irrigators had been required each year to divide the water among those who demanded it, in a short time there would not have been enough to have distributed to any one man, and suffering would have ensued among all instead of among the few. Then again, when persecution banded the Mormons together and strengthened the ties of their communal organization, there was no tendency among the prior appropriators to abuse their monopoly as there is at the present time. The apparent harshness of the law was modified by the willingness of settlers who built their ditches in the fifties to go on the same footing, as regards priority of rights, with those who built theirs in the sixties. There seemed to be no inclination among any of the claimants to regard water as private property, but rather as a public right, to be used in such a way as to obtain the greatest security for agriculture and the largest values for irrigated land. To this system of apportioning the water a wise legislative provision was attached, by which all rights to water passed to the grantee

¹ This Territorial Board of Control has a legal existence to-day in Arizona, and finds its counterpart in the State Boards of Wyoming, Colorado and New Mexico. The only analogous institution in Utah is a County Board of Reference, which is composed of three competent persons appointed by the Water Commissioners of each county, to determine in cases of dispute which county is entitled to the use of water flowing in or through each county and yet having a common source of supply. Compiled Laws of Utah, 1888, Sec. 2776.

44 *The Economic History of Irrigation in Utah.*

of a conveyance whenever a transfer of land was made.¹ This insured the owner of land the right to use the water with which to irrigate his land, and obviated the friction which would have been the inevitable result of divided control.

While the writer believes, for the reasons just enumerated, that the system of priority of rights defined all claims to water at the smallest cost to the owners, and apportioned the water so defined more justly than any other system could have done under the given economic conditions, he is inclined to regard this monopoly as a great injustice to later comers. In a subsequent chapter² a plan will be proposed which it is believed will remedy the condition of these irrigators whose crops suffer from want of water while their neighbors enjoy an ample supply.

¹ Compiled Laws of Utah, 1888, Sec. 2783.

² Chapter iv, Part II.

CHAPTER IV.

TRANSPORTATION AND COMMERCE AS AIDS TO IRRIGATION (1867-77).

Hand in hand with the increase in the internal economies of irrigation in Utah went improvements in its external economies. During the years preceding the completion of the overland railroad the imports of the territory seldom exceeded 12,000 tons, while the exports were insignificant in proportion to the amount produced on the irrigated farm. Commerce with the East and West was slight, supplies being drawn mainly from St. Louis and San Francisco,¹ and paid for in part with the money received for surplus grain, stock and garden produce from passing emigrants.² Brigham Young and other dignitaries of the Church had long since believed that a railroad would bring with it a new and manifest destiny to his people.³ They reasoned that if the surplus which the irrigator could claim as a result of his legitimate labor was to be eaten up by extor-

¹ "In 1849 the settlers were anxious to open a highway to San Diego, whence they intended to obtain supplies. In 1867 it was proposed to use the Colorado route for traffic." Hayes' Scraps, San Diego, ii, 171-193. These were the first attempts to enlarge the consumers' market.

² Wheat, even at this late period, was a favorite medium of exchange. The advertising columns of Zion's newspapers were full of such "For Sale" notices as the following: "For Sale—For cash or wheat, two good English lever watches. McVear & Barlow." Deseret News, February 22, 1861.

³ Brigham Young thought the project of a great continental railroad was feasible, as was shown in the presentation of a memorial to Congress on the subject in 1854. "As early as 1847 he marked out the route over which he believed the great iron way would eventually pass." Whitney, Hist. Utah, ii, 217. "It is a curious fact that for several hundred miles the grade of the great transcontinental railway is made exactly upon the old Mormon road." Tullidge, Quart. Mag., i, 12.

tionate tariffs, charged because of expensive stage line transportation,¹ production must always be limited to a home market, and that in the end it would only be profitable for the laborer to produce the variety of things he consumed. Wagon roads might contribute to the isolation and peace which the Mormons so much desired in 1847, but they could not enhance the prosperity of which the twenty-seven-acre irrigated farm was the embodiment. Conditions had changed, a world's market was vastly more important now than a place of refuge.

The construction of the great transcontinental lines, the Central Pacific and Union Pacific, at a time when the great interior basin of the country was sorely in need of transportation facilities, and more particularly the selection of Ogden as a terminus for these roads,² marks the beginning of the cleavage between an industrial system insuring the laborer his bread and clothing, and an industrial system not only guaranteeing a living, but making a decent provision for old age. A contract for the construction and grading of forty miles of these roads was taken by Brigham Young,³ and although a full payment for the original sum promised (*i. e.* \$1,000,000) was not made by the companies, the Mormons managed to secure \$600,000 in rolling stock and other valuable material. With this material and rolling stock, aided by their system of co-operative labor, a road was built between Ogden and Salt Lake, which was called the Utah Central.⁴ This pioneer road of Utah, constructed

¹ For account of stage line transportation, cf. Burton. *City of the Saints*. Remy, *Journey to Great Salt Lake*.

² The point of junction was Promontory Summit, Utah, a point 53 miles northwest of Ogden, but the latter is justly called the Junction City and is the real terminus of the roads.

³ "The acceptance of a contract by President Young for the grading of a road from the head of Echo Canon to this valley, and the heartiness with which the people manifested a desire to take hold of the job, takes away the thunder of those writers whose capital stock is the wrongdoings and sinfulness of the Mormons." *Deseret News*, June 17, 1868.

⁴ "We have felt somewhat to complain of the Union Pacific Company for not paying us for the work we did in grading so

"without purse or scrip," was undertaken just one week after the completion of the transcontinental line. The gratifying results that followed in the wake of these great highways, encouraging as they did immigration, facilitating trade and marketing agricultural products at remunerative prices for those who produced them, furnished good collateral for the investment of capital in other railway projects.¹ The great highways of commerce thus established brought with them a large interchange of traffic and an increased demand for labor occasioned by this traffic.² Opportunities for employment and the widening of eastern markets to receive the products of Utah's soil encouraged immigration, and immigration meant even better facilities for the transfer of goods than the internal agricultural trade had heretofore fostered.

It has been shown how the development of internal economies through the agency of irrigation had strengthened commerce and introduced improved media of exchange. It was the legitimate result of the self-sustaining policy which had been in vogue for years and which provided that only those goods should be consumed which were produced at home, that barter should be resorted to as a means of conveyance. Well-to-do farmers, with families to support and educate, rarely ever used a dollar in coin.³ If

many miles of their road. But let me say, if they had paid us according to agreement, this road (*i. e.*, the Utah Central) would not have been graded and this track would not have been laid to-day." Hist. Brigham Young, MS., January 10, 1870.

¹ The construction of the Utah Southern from Provo to Juab; the Utah and Northern, from Brigham City to Franklin, Idaho; the Salt Lake and Western, from Lehigh Junction to the Tintic mines; and the Utah division of the Denver and Rio Grande Western, soon followed.

² Not only was there an increase in labor by reason of improved transportation facility, but also by reason of the widening economies in home manufactures. "The number of hands employed in Utah's factories in 1870 was 1534 as compared with 389 in 1860 and 51 in 1850." Hollister, *Resources and Attractions of Utah*, 55.

³ "I remember the day when coin was spurned as legal tender for debts. When I offered my creditors cash instead of wheat they

clothing was needed, the store-keeper would supply him for so many bushels of wheat or pounds of potatoes. If his children were to be educated, tuition was rated in fruits and other products of the irrigated farm. If his wife went to the theatre, admission was usually paid in cabbages. If spiritual advice was necessary for the welfare of the household, the bishop was summoned and received watermelons and green corn for his visits. Small change was not known in the territory, subsidiary coinage being replaced by due-bills. This primitive method of exchange, aided by the irredeemable Kirtland notes, was conducted until the market had been enlarged and the principle of division of labor extended by the advent of the railroads.

Another great result of the coming of the railway was the development of the local mining industry, destined to prove the greatest impetus that irrigation had yet received.¹ Heretofore the mining of gold and silver had been discouraged by the Church authorities, partly with a view of preventing an influx of Gentiles, and partly because the perpetuity of the Mormons as a community depended on their unremitting exertions to produce the necessities of life from their small farm unit. Pioneer prospecting tours had been made as early as 1863; but, owing to the ridicule heaped upon the promoters from the tabernacle,² and inexperience in smelting ores, scarcity of charcoal, and high

indignantly refused it. Wheat was at as much of a premium in 1870 as gold is to-day." *Reminiscences*, Bishop C. F. Middleton, Ogden, Utah, September, 1896.

¹ "One great result of the coming of the railway was the development of the local mining industry. The mining movement rested to await the advent of the iron horse, when cheaper and speedier transportation, reduction in the prices of material and the influx of capital would solve the difficulties surrounding the struggling enterprise and place it on its feet as a profitable industry." Whitney, *Hist. Utah*, ii, 271.

² "The first systematic efforts at prospecting were made by General Connor, Commandant at Fort Douglas in 1863. His efforts were ridiculed in the tabernacle as a scheme 'to invite hither a large Gentile and loyal population.'" Harrison, *Critical Notes on Utah*, MS., 48.

rates of transportation, all attempts in this direction were abandoned. It was recognized that mining in Utah would never be successful until cheaper and speedier transportation could be secured, and until there was such an influx of capital that heavy risks could be incurred without putting the laborer's means of subsistence in jeopardy.

The irrigator, whose perpetual water right was an insurance policy on his crop and whose crop was an insurance policy on a living, could not afford to invest his labor and the annual product of his farm, liable, as it was, to bankrupt his next year's prospects for a livelihood. Yet he realized that inasmuch as the mining camp would be a near neighbor to the agricultural valley, it would furnish a ready outlet for the products of his farm. With the advent of the railroad, capital hastened to this lucrative field for its investment, with the result that between 1869 and 1871 there were mined 10,000 tons of gold and silver ores, valued at \$2,500,000; 4500 tons of gold and silver ore, valued at \$1,237,000; and 231 tons of copper ore, valued at \$6000.¹ This industry, destined to enhance the value of the irrigator's farm and increase the demand for his farm products, developed in such a rapid ratio to the years that a paltry mintage in gold, silver and lead of less than \$200,000 in 1869 amounted to more than \$7,000,000 in 1875.²

The intimate relation between irrigation and other industries now began to be fully appreciated by a people who had heretofore depended on the former alone. Isolation, as a religious tenet, might have been justifiable in days of persecution, but in the heyday of the development of the material resources of his Zion, the thrifty Mormon farmer did not fail to realize that the products of land and the rewards of labor gain in advancing conditions of the com-

¹ Whitney, *Hist. Utah*, ii, 274.

² Prof. J. E. Clayton, in *Utah Gazetteer*, 1884, 56. In Governor's Mess., 1882, 8, the average output of gold, silver and lead between 1870 and 1882 is given at \$6,500,000. This is probably too high, as between 1870 and 1874 inclusive it was less than \$3,000,000, and in no year did the product much exceed \$7,000,000.

munity and in due proportion to the growth of those industries surrounding him.¹

Recognizing that the whole value of his land depended as much upon the reflected labor of outside industry as upon the labor directly expended upon it, that his prosperity would be fostered, encouraged and extended in proportion to the diversification and efficiency of other productive occupations, the Mormon irrigator invested his surplus in the establishment of Utah's great commercial system, known as Zion's Co-operative Mercantile Institution. Prices of imported commodities were still extravagantly high, the total value of the imports being two-thirds of the value of the imports and exports combined. If the balance of trade was to be in favor of the Utah irrigator he must be protected against the high prices of imported goods and obtain his supplies in larger quantities.

Canal-building had established the correctness of the principle on which the Mormon commonwealth was founded, and had given assurance that in the midst of a community prepared by interest, instinct and training to support it, co-operation in mercantile affairs could be made a beneficent reform. On the completion of the transcontinental railway conditions were more propitious for the trial of this system than ever before. Salt Lake City had been the metropolis of the extensive inter-mountain country. Not only the long chain of towns extending through the territory from Idaho to Arizona, but the cities and mining camps of the surrounding territories looked to Salt Lake and Ogden as the sources of their supply. The days of tedious freighting by team from the Missouri river to the Great Basin had ended and competition had begun to quicken Utah's commercial

¹ "When we came here we sought isolation, now we occupy a different position to that which we have ever occupied before. We desire to be more known. We court contact to-day, if it be of the right kind. When we are better known these absurd prejudices which prevail now through the public mind respecting the Mormons and the people of Utah will be dissipated. I am for railroads and mines." Speech delivered by Brigham Young, June 8, 1868.

life-blood. Accordingly, at the October conference in 1868 a resolution was adopted by the Council of the Twelve Apostles pledging the people to be self-sustaining,¹ and the policy was adopted of dealing directly with the eastern houses and supplying at wholesale rates smaller institutions at home, thereby securing control of both the local wholesale and retail trade.

From the first experiment in 1868, commercial co-operation has proven uniformly successful. Purchasing agencies organized on this plan have worked an economy in consumption, because the co-operators owning the stock in the stores have been the consumers themselves, and hence no third parties have intervened to reap a middleman's profit. Cash payments have been insisted upon, and thus preventing loss from bad debts, the co-operative stores have been enabled to give their customers a reduction from current retail prices. Investors as well as consumers have fared well. The annual sales of the Z. C. M. I., from its commencement, have averaged \$3,000,000, and the average of cash dividends paid to stockholders has been $9\frac{1}{3}$ per cent per annum, aggregating \$2,163,000, besides stock dividends to the amount of \$415,000. One thousand dollars invested in the Z. C. M. I. in March, 1869, was worth \$2014.30 in July, 1897, besides earning for its owner \$4378.05 in cash dividends.² A beet-sugar factory at Lehi, Utah, illustrating the idea of productive co-operation as opposed to distributive or consumptive co-operation, in 1897 declared dividends of 10 per cent. The owners of this factory are the farmers who raise the beets, and practically all the capital required for the conversion of the beets into sugar is furnished by this co-operative association of beet-producers. Mormon banking and insurance institutions are organized on the same principle. Those who expect to become borrowers and holders of policies furnish the capital and regu-

¹ Utah Religious Pamphlets, ix, 10.

² Annual statement of the Z. C. M. I. At present this institution has a capital of \$1,077,000, and maintains a reserve fund of \$200,000.

52 *The Economic History of Irrigation in Utah.*

late the condition of its lending and repayment. Even small farmers unite in shipping their produce, and form local companies for the purchase of farm implements and machinery at wholesale prices. This principle of co-operation may be easily attributed to the first school, the beginning of all wealth in Utah—irrigation. For it was the united action of shareholders in building canals that enabled men without capital or credit to organize colonies and enter upon desert wastes without incurring any indebtedness, floating any bonds or expending any money in the work.

But if irrigation suggested and developed co-operative enterprise, co-operative enterprise repaid the debt by enlarging and diversifying the market for the irrigator's product. The associated advancement of closely related industries naturally had its influence on the moral, social and economic advancement of individuals and communities. Improved tastes led to a greater variety in demand, and diversified demand increased the value of the product out of which the wages of the irrigator were paid.

Between 1860 and 1870, 277 canals were constructed, representing a total length of 1043 miles and irrigating 153,949 acres.¹ At this time the average first cost of the water right for the entire territory, with its varying conditions of topography and climate, was estimated to have been \$15 per acre. This was the cost of bringing the water to the land. Inasmuch as the canals and ditches were built principally by the irrigators themselves, the cost of the water right represented the value of the labor of the farmer, reckoned on the basis of \$0.50 to \$2 per day for a laborer and \$4 per day for a laborer and a team.² An estimate of the first cost of the water right was larger in 1870 than it is now, because the wages of labor were paid partly in currency and partly in certificates of barter having comparatively no purchasing power. These certificates could

¹ Smith's *Rise, Progress and Travels*, 23.

² Calvin Reasoner, *Reminiscences*, MS., 1870.

be disposed of in exchange for lumber used for flumes and timber and stone used in constructing dams or making bridges of travel, but not for merchandise.¹ The average cost included all cases, from the one extreme, where the farmer dug or ploughed his water ditches unaided, to the other, where he made a cash purchase of the water right from some association or corporation.

The average estimated value placed by the irrigator upon his water right was \$25. This was the price which the water right whenever transferable without the land, usually brought in the various localities, the value of these rights being determined largely upon the probabilities of the owner receiving the amount of water claimed. Besides the first cost of the water right, the irrigator had to pay either in cash or labor expended, for cleaning out sediment and often for renewing the dams and head-work. The cost ranged from \$0.25 per acre to \$3 per acre, the average being \$1. The cost of preparing wild land for cultivation, excluding the cost of water, but including ploughing, grubbing, cutting brush, fencing and leveling, averaged \$14.85. The original price of the land was the government rate under the Homestead Law, viz., about \$0.12 per acre. The annual value of the farm products averaged \$13.29 and the assessed valuation of the land averaged \$15.50. Adding the several items of expenditure and revenue, we have the following estimate based on an acre unit:

EXPENDITURE.	REVENUE.
First Cost of Water-Right. \$15.00	Value of Water-Right. \$25.00
Annual Cost of Water. 1.00	Annual Value of Products 13.29
Cost of Cultivation. 14.85	Value of Land 15.50
Original Cost of Land. .... .12	
Profit to Irrigator 22.82	
<u>\$53.79</u>	<u>\$53.79</u>

This table shows a profit to the irrigator, less cost of improvement, of \$22.82. In 1870 there were 58,936 acres of irrigated land in Utah; so, after deducting the amount

¹ Joel Shoemaker, Co-operative Irrigation, 3.

54 *The Economic History of Irrigation in Utah.*

expended for the primary improvement of the land in order to make it fit for irrigation from the total value of the irrigation plant, we have $58,936 \times \$22.82 = \$1,344,919.52$ as the irrigation surplus for that year.

The agricultural reports from 1871 to 1877 inclusive show that there was not only a larger percentage of improved land in Utah than in any other State or Territory of the arid region, but that the value of her farm products per acre was greater than on the southern plantation.

CHAPTER V.

RECENT LEGISLATION (1877-97).

Utah was at this time the granary of the inter-mountain country. Yet only 6,000,000 of the 54,065,000 acres in its public domain had been appropriated. This failure to utilize the great bulk of the public land for farming and ranging purposes was due, in a measure, to the unsatisfactory character of the land laws under which entries could be made. The provisions of the Homestead law, passed May 20, 1862, were liberal as far as the purchase price of land was concerned, but they were looked upon as harsh by many, in so far as they provided for a five years' residence before appropriation, and limited the pre-emption to 160 acres.

To meet the needs of many settlers who wanted a larger acreage under cultivation and who objected to the residence qualification, an act was passed by Congress, March 3, 1877, known as the Desert Land Act, permitting the entry of 640 acres, requiring that water be put upon the same by claimants and the land paid for at the rate of \$1.25 per acre.¹ The passage of this act undoubtedly effected the reclamation of many arid acres that would not

¹ The Government has now five principal methods for the disposal of its land: viz. (1) Pre-emption. The pre-emptor goes upon the land, improves it and resides there continuously for six months, and at the expiration of the required time by making proof of his residence and improvements, and paying the sum of \$1.25 per acre, he is entitled to a patent (cf. U. S. Rev. Stat., Secs. 2257-88). (2) By the Homestead Law, which requires five years' residence and the payment of \$18 for a pre-emption of 160 acres (Ibid., Secs. 2264-65). (3) By public sale and private entries. Congress may authorize the President to issue an order exposing certain lands for sale. And after having been offered at public auction for a period of two weeks, the lands remaining unsold are held subject to private entry and sale (Ibid., Secs. 2253, 2260). (4) By the issuance of military

have been touched under the provisions of the Homestead law. However, the writer is inclined to believe that it has outlived its days of usefulness. Ostensibly in the interest of the settler, it is really in the interest of those who desire to acquire the public lands and waters for private speculation. Few individuals possess the capital to build the dams and to dig the canals necessary for the irrigation of 640 acres, and the result is that entries made under this act are usually made by corporations. These corporations send "straw-men" to enter the lands in their names, divert the water out of its natural channels, and by virtue of their control of the water supply, own the land and own the man who builds his home upon it.

The passage of what is known as the Carey Act, August 18, 1894, marks an epoch in the history of irrigation in Utah, and forms the nucleus around which will cluster all the problems confronting Utah's irrigators in the immediate future.¹ This act, framed by Senator Carey of Wyoming, bound the Government of the United States to donate not to exceed 1,000,000 acres of desert land to each State and Territory in which the land is situated, for purposes of reclamation and colonization.

The essential features of the Carey Act are as follows: Before the application of any State is allowed, or the segregation of any of the land from the public domain is ordered by the Secretary of the Interior, the State is compelled to file a map of the land, which shall exhibit a plan showing the mode of the contemplated irrigation and the sources of the water supply to be used. If this map is approved by the Secretary of the Interior, any State accepting the dona-

warrants. Military land warrants may be issued by act of Congress to individuals for military service, the lands so granted to be known as bounty lands. The disposal of land under a military land warrant is more in the nature of a sale than a grant or donation, the purchaser being compelled to pay the minimum price (Ibid., Secs. 2414, 2423). (5) By the Desert Land Act (cf. 19 Stat. at Large, 377).

¹ For provisions of the Carey Act, cf. House Exec. Doc., 53d Congress, 1st Sess., 306.

tion is authorized to make all necessary contracts to cause the lands to be reclaimed and to induce their settlement and cultivation. The State, however, is not authorized to lease any of the lands thus donated if the lease does not guarantee their reclamation and settlement.

As soon as the State can furnish satisfactory proof that the lands are irrigated and occupied by actual settlers, patents are issued to the State on two conditions: (1) That the State is not to dispose of more than 160 acres of land to any one person. (2) That any surplus of money derived from the sale of the lands in excess of their cost of reclamation shall be applied to the reclamation of other desert lands in the State.

The Constitutional Convention of the new State of Utah, in session from March 4th to May 8th, 1895, accepted this grant of 1,000,000 acres on behalf of the people of Utah, and, as we shall see later, the State legislature, at its second regular session in 1897, devised a plan for the administration of the grant. The following suggestions in regard to the Carey Act present themselves:

(1) Utah can instantly repeal the Desert Land Act so far as it relates to tracts that the State may wish to reclaim. This is true because under the Desert Land Act it is provided that 320 acres may be taken up by an individual settler, and that his wife is entitled to 320 acres more; while the Carey Act provides that only 160 acres can be sold to any one person. The title of the Carey Act, viz., "An Act Amendatory of the Act to provide for the sale of Desert Lands in certain States and Territories, approved March 3, 1877," clearly shows that the evils of monopoly prevalent under the Desert Land Act were carefully guarded against by the author of the Carey Act.

(2) The Carey Act places a large tract or tracts of land (for the segregated land need not necessarily be "bunched") into the hands of the State already holding the unappropriated waters within its borders, thus making the ownership of the land inseparable from the ownership of the

water and guaranteeing capital gilt-edge security for investment. At the same time better opportunities are open for the small investor, because he can better afford to purchase water sufficient to irrigate 160 acres than water sufficient to irrigate 640 acres, as provided for by the Desert Land Act.

(3) The Carey law is a compromise between the conflicting principles of unconditional cession of the public lands to the State in which they are situated for purposes of reclamation, and the reclamation of these same lands by the general government itself. For, by the Carey Act, the Government gives to the State great powers to the administration, while retaining the title of lands conditionally ceded until satisfactory proof of their reclamation has been made.

The people of Utah, through their lawmakers, will not only be compelled to deal with the problem of administration in connection with the Carey grant, but also in connection with the substantial dowry that the new State received from the Government on its admission into the Union. The Enabling Act, approved by the President, July 16, 1894,¹ ceded public lands amounting to 7,524,000 acres for the following specific purposes:

	Acres.
Public buildings at capital of State.....	64,000
University of Utah, additional grant....	110,000
Agricultural College	200,000
Irrigation reservoirs	500,000
State Insane Asylum	100,000
School of Mines	100,000
Deaf and Dumb Asylum	100,000
Reformed School	100,000
Normal School	100,000
Institution for the Blind	100,000
Miners' Hospital	50,000
Educational purposes	6,000,000
Total	7,524,000

¹ House Exec. Doc., 53d Cong., 1st Session, 192.

The Utah Irrigation Commission has estimated that of this amount 1,304,000 acres are susceptible of irrigation, the rest being forest and grazing land.

The second regular session of Utah's Legislature, which adjourned March, 1897, contributed in no small degree to the irrigation laws of the State. Of these laws, the most important was the act known as "The acceptance of the Carey Law."¹ Under the provisions of this act any person or company desiring to reclaim any portion of the 1,000,000 acres ceded by the Carey Law must file with the Land Board an application for the selection of the lands to be irrigated. The application must be accompanied by a proposal to construct the necessary irrigation works, with a statement of the plans. The board is required to give public notice for thirty days of such application, and if the same is approved, to apply to the United States Land Office to have the land selected withdrawn from sale. When withdrawn, the board may make a contract with the applicant to construct the works, which are to be sold to settlers with the water rights. All contracts expire April 1st, 1903. Such lands may be purchased from the State upon the payment of at least 25 cents per acre, the balance on such terms as may be prescribed. No lands can be sold for more than \$1 per acre. If the irrigation company fails to furnish water to settlers, the State is authorized to refund the price paid by the settlers on the land. The irrigation company constructing the works is given the right to sell the water rights attached to the land, and also a prior lien on the lands reclaimed until all dues are paid. Failure to pay the annual maintenance tax and the cost of the water rights thus constitute a lien on the settlers' lands. This plan for the administration of the Carey grant is certainly a step in the right direction, affording, as it does, an ample guarantee by the State of the settler's rights and at the same time an incentive to private enterprise. It is to be regretted, however, that the administrative policy thus formulated was

¹ Cf. Senate Bill 62, Utah State Leg., 2nd Sess.

not extended to the 1,304,000 acres of irrigable land ceded to the State by the provisions of the Enabling Act, and the writer, in Part II of this monograph, will urge the necessity of the extension of a similar policy to all lands ceded to the State by the National Government as a prerequisite to further State cession.

A second law of practical interest to irrigators, passed by the last Legislature, was one providing for the methods to be followed in appropriating water.¹ The essential features of this law were the adoption of the cubic foot per second, or second-foot, and the acre-foot,² as the standard units of measurement, and the provision for right of way by just compensation across private lands for canals, flumes, tunnels and reservoirs. Details of this law are: (1) Seven years' disuse of water rights constitutes forfeiture. (2) Appropriators of water are required to post notices at the point of the proposed diversion and at the nearest post-office thereto, stating the number of cubic feet per second claimed, the purpose for which it is claimed, if for irrigation, the number of acres to be irrigated, the means of diversion, the size of the flume, ditch-pipe or aqueduct, the date of appropriation and the name of the appropriator. Within twenty days thereafter the appropriator is required to file with the county recorder a notice of appropriation, verified by affidavit, and within forty days to proceed to the work of directing the appropriation. This legal definition of the methods to be followed in appropriating water, if rigidly observed, will doubtless eliminate some of the confusion which exists as to the nature and extent of appropriators' rights, but it is doubtful as to whether the law can be enforced without the existence of an effective board of state control. Hence, the writer will subsequently recommend the creation of such a board in order to secure this enforcement and to define all claims to water at a small cost to the owner.

¹ Cf. House Bill 142, Utah State Leg., 2nd Sess.

² The acre-foot is equivalent to 43,560 cubic feet.

A third and most timely measure passed by the last Legislature in the interests of the irrigator was the creation of the office of State Engineer.¹ It is strange that this office was not created years ago, inasmuch as irrigation has been the corner-stone of Utah's prosperity since its first settlement. The writer ventures the opinion that only the peculiar social and religious customs of the people could have made possible so extensive a development without the official supervision which other States have secured through the agency of an engineer.² The principal duties of the State Engineer of Utah, as prescribed by the law creating the office, are (1) The examination of all reservoir sites and the submission of plans for the construction of reservoirs, dams and canals to the State Land Board; (2) the supervision of new dams and inspection of old ones; (3) the formulation of an effective system of water administration by finding out the dimensions of canals and ditches as originally constructed and enlarged, the date when water was first used for irrigation and other beneficial purposes, and if used for irrigation, the amount of land reclaimed the first year, the amount in subsequent years, the date of reclamation and the amount of land such ditch is capable of irrigating; (4) the furnishing, free of charge, of information as to the proper method of measuring water or making apparatus for its measurement, with special instruction thereon to all water-masters; (5) the location, examination or supervision of dams or embankments for private individuals, on the payment by those individuals of a per diem of \$4 and expenses, "all moneys thus received to be paid monthly into the state treasury."³ The effectiveness of the law, the writer fears, will be to a large degree neutralized by the meagre salary attached to the office, namely, \$1000

¹ Cf. House Bill 34, Utah State Legislature, 2nd Sess.

² Colorado, California, Idaho, Nebraska and Wyoming have had competent State Engineers for several years.

³ Willard Young, a most competent engineer, was appointed to the office of State Engineer, created by this Act.

per year and actual traveling expenses; and it is to be hoped that the next Legislature will see fit not only to increase the salary of the Engineer to a degree commensurate with his duties, but also to provide for an assistant, whose duty it shall be to transact the routine business of the office.

Summing up the results of recent legislation, we see that the Desert Land Act furnished a more liberal title of occupancy to the settler than the Homestead Law; that the Government, by the passage of the Carey and Enabling Acts, shifted the responsibility for the reclamation of many of its lands on the State; that the State, by accepting the conditions of the Carey grant and making provision for its administration, by defining more rigidly the methods of appropriation, and by creating the office of State Engineer, placed Utah's industrial development on a comparatively secure foundation.

CHAPTER VI.

CAPITALISTIC IRRIGATION (1890-)

The evolution of irrigation in Utah has followed a natural course; beginning with a small stream that a single farmer or small group of farmers could divert and use; then the larger creek, calling for the combined effort of the community; and finally, the larger undertakings by which thousands of acres are reclaimed under a single system of works where it is necessary to obtain outside capital for their development.

Capitalistic organizations, requiring the investment of large sums of money by the sale of bonds, had their germs in Utah in 1868, when the first survey was made for a canal to convey the waters of Bear River upon the parched yet fertile lands of Bear River Valley.¹ The undertaking was so great in its magnitude that Congress was petitioned to make an appropriation and aid well-known capitalists in the construction of the canal. The petition was refused, and it was only after several unsuccessful attempts had been made to secure the immense amount of capital required that the Bear River Irrigation Company in 1889 commenced the construction of the canal at a cost of over \$2,000,000. Not only was this canal a work of great magnitude and cost, but it presented almost insurmountable engineering difficulties. At the initial point where Bear River leaves Cache Valley and cuts its way through the mountain range

¹ The description of the Bear River Valley and its abundant water supply, and the estimates of the cost of the enterprise, were furnished to the writer by William H. Rowe, Ex-President of the Bear River Canal and Ogden Waterworks Co., Ogden, Utah. His successor, Mr. Wm. Adamson, writes that the company contemplates putting 11,000 acres under irrigation during the summer of 1898.

into the Salt Lake basin, a dam was constructed on the solid bed-rock of the river, requiring 750,000 feet of square timber put together with 30 tons of bolts—the whole structure being supported by a solid masonry wall extending across the channel and back 200 feet. Having checked the progress of the rapid torrent, the desired volume of the water was carried through the rocky walls of a gorge for a distance of six miles. Every foot of this canal, 15 feet wide and 10 feet deep, was either built of masonry or tunneled through solid rock. Fifty-two carloads of giant powder were used in blasting this rock, while the company had a pay-roll of 7000 names.

At a point six miles from the head-gate the main canal divides, one section known as the Point Lookout Branch going off upon the rim of the valley on its right; while the other, known as the Corinne Canal, runs through the valley between the river and the other branch. The aggregate length of the two main canals is ninety-seven miles, from which laterals to the extent of forty miles had been made for the purpose of reaching and irrigating the numerous lands under cultivation. The capacity of the main canals in operation is 1000 second-feet, an ample supply for 150,000 acres. This is less than one-third of the available water supply; for at its lowest the Bear river flows more than 3000 cubic feet, while at its flood stage it delivers as much as 20,000 cubic feet per second. So perfect is the canal in all its features—in permanency of construction, carrying capacity, perfect gradients and absolute guarantee of water supply—that the highest award was given to the Bear River Canal at the World's Fair. The feature that decided the contest was the fact that the supply and carrying capacity enabled the Bear River Company to sell and convey to each and every purchaser of water one cubic foot per second for each eighty acres of land. According to the accepted figures of irrigators and irrigation engineers, one second-foot of water is generally sufficient to water one hundred acres.



BEAR RIVER CANAL, SHOWING STONE CUT AND TUNNEL.

Naturally a valley containing a tract of 175,000 acres, traversed by a canal having an irrigating capacity of 150,000 acres, has attracted the attention of home-seekers and proved inviting to capital. Already two large capitalistic organizations have purchased practically all the land in the valley, and are offering settlers very flattering opportunities for investment. In 1895, 16,000 acres of this land were irrigated, the unit of distribution among purchasers being a twenty-acre farm. Experience has proven that an orchard is more profitable than general crops on a highly cultivated irrigation farm; and although there was a wheat yield of over 100,000 bushels last year in the Bear River Valley, the bulk of the land is planted in fruit trees.

The terms offered by the company are very reasonable, and show a disposition to encourage the orchard industry to its fullest extent. Whenever a compact is made with the company an obligation is assumed by the company to furnish the land with a perpetual water right of one cubic foot of water for every eighty acres of land purchased; to plough, cultivate and irrigate the land; to prune, spray and care for the trees until the orchard is delivered to the purchaser, bearing fruit at the end of six years; and to pay all taxes, water rentals and charges of every description during the six years prior to the delivery of the orchard to the purchaser. The obligation of the purchaser is to pay \$3 per month during six years for each acre, at which time the company will deliver to him a fruit-bearing orchard, which, it is estimated, will produce, the first year after delivery, 15,000 pounds of fruit per acre, worth \$0.01½ per pound in the orchard. When it is considered that cold-storage houses, evaporating works and canning factories have been erected on these small fruit farms, thus insuring the producer the profit directly without loss through commission houses, that assurances have been given by reliable fruit transportation companies that there will always be a market for the product of Utah's orchards regardless of the supply; the profit on capital invested would seem to be an

unearned increment, yielded because of the bounty of nature and not because of risk incurred.

Although the construction of the Bear River works marked the introduction of a new principle into the economic life of Utah, inasmuch as the contemplated canals were beyond the reach of co-operative labor and, of necessity, must have been built as large public works or as private enterprises; the construction of these works by a corporation did not represent the rise of the speculative spirit, which Brigham Young fiercely and successfully opposed in his lifetime, and to which the Mormon people stand firmly opposed to-day. True, under this wonderful canal system there has been a great enhancement in land values, but this enhancement accrues as a profit to the purchaser and not to the company. True, the waters of a great river had been appropriated and are controlled by a corporation, but the value that resides in the water is transferred as a perpetual water right to the purchaser, and does not serve as the basis of an iniquitous water rental. The water inures to the land in perpetuity, and the land is held in individual ownership by the purchaser, so there is no monopoly of either land or water, and none of the evils resulting from separate ownership are fostered.

Emulating the success achieved by the Bear River Irrigation Company, other large corporations have interested themselves in the problems of conserving the water supply and reclaiming the arid lands of the State.

Among these, the most representative in point of capitalization and the extent of works are the Mt. Nebo Land and Irrigation Company and the Lake Bonneville Water and Power Company.

The Mt. Nebo Land and Irrigation Company, incorporated in 1897 with a capital stock of \$600,000, of which \$500,000 has been paid up, has constructed a dam 28 feet high by 150 feet long, and also owns a storage reservoir 6 square miles in area with a storage capacity of 19,000 acre-feet. Of the 25,000 acres of land controlled by the

company, 3000 have been irrigated and are now devoted to the culture of beets. These lands are most favorably located—near the south end of Utah Lake, guaranteeing abundance of water for irrigation purposes; only 20 miles from the big beet-sugar factory at the town of Lehi, insuring a ready market for the beets raised, and along the line of the Rio Grande Western Railway, thus enjoying good transportation facilities.¹

The Lake Bonneville Water and Power Company was incorporated in 1897 with a capital stock of \$3,000,000, of which \$1,000,000 has been paid up. Heretofore this company has restricted its operations to the reclamation of 15,000 acres in Millard county, but the writer is advised that during 1898 it will extend its projects of reclamation to a degree commensurate with its capital and plant. The company is constructing an immense dam upon the Sevier river, covering an area of over 10,535 acres and having a storage capacity of 382,000 acre-feet. Leading from this reservoir to the lands to be reclaimed it is designed to run two canals through the Lemington Canyon. These canals are to be 30 feet wide at the bottom, 50 feet wide at the top, and 10 feet deep, and are to have an approximate length of 140 miles with 750 miles of laterals. This industrial undertaking will be particularly important to the irrigators of Utah, not only on account of its magnitude, but because it

¹ As this monograph goes to press, the writer learns that Chicago capitalists have purchased the entire plant of the Mt. Nebo Land and Irrigation Company, and during the present year contemplate spending \$500,000 in the erection of a beet sugar factory on the property itself. The new company will be known as the Mt. Nebo Beet Sugar and Land Company, and will have a capitalization of \$1,000,000, divided into 10,000 shares of \$100 each. What the terms of the transfer were cannot be ascertained. That the transaction was a large one, however, is sufficiently shown by the fact that C. T. Gregory of New York, the expert who examined the property for the purchasers, valued it at \$750,000. The official directory of the new company is: President, T. A. Simons, of New York; Vice-president, Dr. T. B. Beatty, of Salt Lake City; Treasurer, W. S. McCormick, of Salt Lake City; Secretary, Gill S. Peyton, of Salt Lake City.

will test the wisdom of the policy of granting the irrigable land held by the State to private corporations for purposes of reclamation. Under the provisions of the act known as "The acceptance of the Carey Law"¹ the State has made a contract with the Lake Bonneville Water and Power Company for the reclamation of 215,563 acres of arid land in Millard county, located in the basin of the old Lake Bonneville, and 38,000 acres of school land located among the other lands to be reclaimed. According to the terms of the contract the company agrees to construct the necessary irrigation works and to return the lands to the State by April 1st, 1903, with water rights attached, and ready for sale to actual settlers; and the State agrees to give the company the right to sell all water rights appurtenant to the land. The proposition which the State and company make to the intending settler is this: The State, the owner of the land, will sell it in tracts of 160 acres or less to actual settlers for \$1 per acre, one-quarter of which is payable in cash and the balance in three years, without interest. The company, the owner of the water, will sell a permanent water right per acre for \$15, upon twenty years' time at 7 per cent interest, and will guarantee an annual water supply at a maintenance charge of \$1.50 per acre for five years, and \$1 for every year thereafter. The company has already given earnest of being a *bona fide* enterprise by the expenditure of \$50,000 in preliminary surveys, and it is expected that by May 1st of the present year the canal system will be under headway. Its success would seem to be guaranteed by the responsible financial character of the stockholders.²

A unique irrigation corporation is seen in the Adams and Keisel Salt Company of Syracuse, Utah. This company was organized in 1888 for the manufacture of salt from the

¹ Cf. Senate Bill 62, Utah State Legislature, 2nd Sess.

² The Directory of the Company is: President, M. B. Hirsh, of Philadelphia; Vice-president, T. B. Beatty, of Salt Lake City; Sec'y, J. A. Street, Salt Lake; Genl. Mngr., T. H. Cavanaugh, of Philadelphia.

waters of Great Salt Lake, but finding that its salt farm on the lake was also adapted to the raising of fruit, the company constructed an irrigation reservoir and sixteen artesian wells. The experiment has proven a success, and 1200 acres of this farm are now subject to irrigation.

The Pioneer Electric Power Company of Ogden, organized primarily to generate electricity by the utilization of water power, has also made irrigation a by-product of its enterprise. With a masonry dam 400 feet long and 60 feet high and a canal system of about 35 miles, this company controls 18,000 acres of irrigable land which is offered for sale at \$30 per acre with water-rights attached. One-sixth of the purchase price is required to be paid when the purchase is made; the balance, in five equal annual installments bearing 8 per cent interest. With a capital stock of \$1,000,000 and the financial support of the First Presidency of the Mormon Church and of Mr. Joseph Bannigan, a multi-millionaire of Providence, Rhode Island, the Pioneer Electric Power Company seems destined to have a brilliant industrial future. This enterprise is noteworthy not only because of its large plant and stout capitalization, but also because it illustrates the favorable attitude of the Mormon Church toward capitalistic irrigation.¹

Without going into further details, the writer submits the following table showing the status of some of the largest irrigation corporations in Utah to-day:

¹ Wilford Woodruff, George Q. Cannon and Joseph F. Smith, constituting the First Presidency of the Mormon Church, are directors of the Company. The official directory of the Company is: President, George Q. Cannon, of Salt Lake; Vice-president, John R. Winder, of Salt Lake; Secretary, C. K. Bannister, of Ogden; Manager, Senator Frank J. Cannon, of Ogden.

TABLE SHOWING STATUS OF LARGE IRRIGATION CORPORATIONS IN UTAH.¹

Name of Company.	Date Incorporation.	Capital Stock.	Average Irrigated Acreage.	Acreage Subject to Irrigation.	Places of Business.
Alturas Land and Navigation Co.	April 9, 1890,	\$500,000	4,000	12,000	Salt Lake City.
Armstrong Land and Water Co.	Oct. 8, 1892,	500,000	3,000	15,000	Salt Lake City.
Bear River Irrigation and Ogden Waterworks Co.	Jan. 21, 1895,	2,400,000	11,000	94,000	Ogden.
Beaver Valley Land and Irrigation Co.	May 22, 1894,	500,000	5,000	30,000	Salt Lake City.
Cache Valley Land and Canal Co.	May 8, 1890,	1,000,000	9,000	35,000	Ogden.
Central Utah Land and Irrigation Co.	Feb. 3, 1890,	1,000,000	7,500	35,000	Clear Lake.
Clear Creek Land and Irrigation Co.	Oct. 30, 1893,	300,000	4,500	25,000	Salt Lake City.
Clear Lake Land and Irrigation Co.	Nov. 30, 1892,	500,000	.....	25,000	Clear Lake.
Davis and Weber Counties Canal Co.	Feb. 2, 1891,	200,000	8,000	20,000	Ogden.
Deseret Reservoir and Irrigation Co.	Mar. 6, 1885,	50,000	11,000	25,000	Deseret.
Fairview Reservoir and Irrigation Co.	Jan. 27, 1893,	300,000	.....	20,000	Fairview.
Lake Bonneville Water and Power Co.	July 7, 1897,	3,000,000	.....	250,000	Salt Lake City.
Lucern Land and Water Co.	May 24, 1892,	50,000	3,000	10,000	Salt Lake City.
Marysville Reservoir Co.	Feb. 27, 1894,	300,000	.....	30,000	Marysville.
Mt. Nebo Beet-Sugar and Land Co.	Jan. 17, 1898,	1,000,000	3,000	15,000	Salt Lake City.
Oquirrh Water and Land Co.	July 15, 1891,	400,000	8,000	22,000	Salt Lake City.
Payetta River Canal and Land Improvement Co.	May 5, 1890,	100,000	3,500	10,000	Salt Lake City.
Pioneer Electric Power Co.	Nov. 27, 1893,	1,000,000	4,000	18,000	Ogden.
Price River Reservoir and Irrigation Co.	Dec. 2, 1895,	1,000,000	8,000	40,000	Salt Lake City.
Snake Valley Land and Water Co.	Feb. 20, 1890,	1,000,000	10,000	50,000	Salt Lake City.
Swan Lake Reservoir and Canal Co.	Mar. 3, 1890,	1,000,000	10,000	50,000	Salt Lake City.
Utah Water Co.	April 24, 1890,	300,000	2,000	10,000	Salt Lake City.
Weber Canal Water Co.	July 2, 1892,	300,000	6,000	15,000	Ogden.

¹ Compiled from county records and statements made by the general managers of the companies in question.

Wherever capital is invested in irrigation enterprise, the profit of the irrigator is larger than on the co-operative farm. This is shown by the following table, constructed on the basis of returns received from the Bear River Irrigation Company's farm, near Corinne, and from a farm, near Ogden, cultivated on the old co-operative plan:¹

EXPENDITURES.		
Co-operation.		Capital.
Cost of water-right . . .	\$10.55	Total expenses met by
Annual cost of water . .	.91	company on payment
Cost of preparation for		by irrigator of \$3 per
cultivation	14.85	month for six years,
Purchase price of land .	.12	\$36.00 per year.
Total	\$26.63	\$36.00
Bal. favor co-operation .	9.37	
	\$36.00	\$36.00
REVENUES.		
Co-operation.		Capital.
Value of water-right	\$26.84	\$28.12
Value of products	18.03	37.00
Value of land	84.25	92.50
Total	\$129.12	\$157.62
Balance in favor of capital	28.50	
	\$157.62	\$157.62
Balance in favor of capital (revenues)		\$28.50
Balance in favor of co-operation (expenditures)		9.37
Net balance in favor of capital		\$18.13

While the expense column indicates a slight balance in favor of co-operation, this balance tends to a minimum as the periods become longer. For at the expiration of a given time (six years in the case of the Bear River Company), payment by the individual truck farmer ceases, and he is guaranteed possession of a productive irrigated acreage. The land with the water-right inures to him in perpetuity, and the company further agrees to maintain and repair the canal, that is, to meet the annual water cost, for

¹ This calculation is made on the basis of an acre unit.

72 *The Economic History of Irrigation in Utah.*

the regular charge of \$0.91 after the expiration of the time specified in the contract. As yet no allowance has been made for the larger volume of water and the better security of the water-right furnished by the company. These are important considerations, for a storage reservoir naturally insures a larger water supply than can be furnished by a co-operative canal; and again, the assumption by the company of the responsibility in regard to the validity of the title to the water-right makes the water-right more secure than under the co-operative system, where a priority may defeat what is supposed to be an established water-right.

A critical study of the revenue column shows that a higher value is placed upon the water-right obtained by purchase from the company, because the validity of the right is guaranteed; that the annual products of the land are larger, because capital has made possible better agricultural methods in the cultivation and improvement of the land prior to its transfer to the individual irrigator; that the estimated value of the land is greater, because the water-right appurtenant to the land is more secure, the acreage product is larger, and better markets are open for the sale of the increased product by reason of a qualitative improvement in the fruit, vegetables and cereals raised.

These direct benefits conferred by capital are intimately related. As the acreage product becomes larger, the value of the water-right becomes greater. As better markets are opened, the product becomes larger and realizes a better price. It is an axiom, tested by experience, that an increase in the value of one of the factors in irrigation development is accompanied by a corresponding increase in the value of the others. This "pari-passu" movement of the factors in irrigation development is illustrated by the following table:

Method.	Year.	Value Product.	Value Water-right.
Co-operative,	1873	\$13.29	\$19.50
Co-operative,	1889	18.03	26.84
Capitalistic,	1897	37.00	31.12

In addition to the direct benefits mentioned above, certain indirect benefits have resulted from the organization of the irrigation industry on the larger capitalistic scale: (1) Better agricultural implements have been introduced, not only enabling the irrigator to do far more work in a given time, but to produce a larger harvest, measured by quantity in ratio to a given amount of labor under the co-operative system. The history of co-operation in Utah has been a history of labor, so that it was but natural that the introduction of labor-replacing machines should have been looked upon with disfavor by the disciples of that system. (2) By enlarging the scale of production, capital has secured better transportation rates for that part of the irrigator's product not used for home consumption. Under the co-operative system a great many individual contributions were required to make carload lots; while under corporate management the produce per acre has so increased by reason of better methods of cultivation being introduced that a twenty-seven-acre unit frequently furnishes a carload lot for shipment. As the volume of exports has increased, transportation rates have correspondingly diminished. Carload rates, quoted at \$250 in 1890, had decreased to \$196 in 1895. (3) Large capitalistic enterprises have provided facilities for canning fruit and vegetables raised on the irrigated farm, and thus much of the truck wasted under co-operative management is saved under corporate.

In general, it may be said that through the agency of capital the waters from mountain streams have been impounded, natural lakes have been utilized, and artesian wells have been bored.¹

¹ The artesian well within recent years has proven one of the most important adjuncts of irrigation in Utah, so much so that in 1895 there were over twenty-five hundred of them in use. An artesian well irrigates, on the average, 4.74 acres; its average cost is \$77.60, or \$16.37 per acre. (Cf. Eleventh Census, Agriculture by Irrigation, 1890, 14.) They have proven profitable in Utah where the surface supply of water has been small. Another advantage of an artesian well is that a farmer may sink it on his own lands so deep that his neighbors cannot use any of his water, and thus he has no trouble in establishing a prior right to the use of the water flowing from it.

CHAPTER VII.

DEVELOPMENT OF AGRICULTURE THROUGH IRRIGATION.

It is said that when Brigham Young first entered the Salt Lake Valley he was told by Colonel Bridger, the leading authority on agriculture in the Arid Region, that for every ear of corn grown in Utah he (Bridger) would give him ten dollars. When this pessimistic prophecy is contrasted with the fact that in 1897 the average yield of corn per irrigated acre in Utah was 22 bushels, the power of irrigation as an agricultural factor will be realized.

The following tables, compiled from official statistics, are submitted as showing the status of irrigation in Utah in 1894,¹ the number of irrigated farms, their cash value, the acreage irrigated, the number of irrigators, the expenses and revenues of an average irrigated farm, the total and average yields of crops grown thereon, their estimated value as a whole and taken separately; Utah's rank with other States and Territories of the arid region; the classification of its irrigated farms according to tenure; the increase in the number, acreage, value and production of its irrigated farms since 1850; a comparison of average yields in Utah with average yields in certain representative States and in the United States at large; and finally, a comparison of irrigated yields in Utah with "dry farm" yields.

¹ The year 1894 is the latest year for which the agricultural returns of Utah are complete. The acreage, production and value of the principal crops for 1897 are available, and are utilized in tables 8, 9 and 10.

TABLE NO. 1.

GENERAL FARM STATISTICS FOR UTAH (1894).¹

(IRRIGATED AND DRY FARM LANDS).

Total Population	247,324
Number of Owners of Farms (5.06% of population).....	12,414
Number of Irrigators (92.46% farmers).....	11,477
Area of State, Land Surface (82,190 square miles). Acres,	52,601,600
Total Area Covered by Ditches.....	1,035,226
Area Irrigated in 1895.....	417,455
Area of all Farms (84.2% Improved).....	1,785,732
Area in Wheat, Average Production—22.4 bu. per acre, acres,	109,086
Area in Corn, “ “ 20.3 “ “ “	8,918
Area in Oats, “ “ 33.9 “ “ “	27,407
Area in Barley, “ “ 30 “ “ “	6,366
Area in Rye, “ “ 20 “ “ “	39,135
Area in Hay, “ “ 2.56 tons per acre, “	179,575
Area in Potatoes, “ “ 172 bu. “ “	6,191
Area in Beets, “ “ 8.08 tons “ “	3,056
Total Value of all Farms, including Land, Fences and Buildings.....	\$48,778,893
Estimated Total Value of the Farms Irrigated in whole or in part.....	\$42,164,688
Estimated Value of all Farm Productions Sold, Con- sumed, or on Hand.....	\$ 6,950,000
Estimated Value of Productions, as above, from Farms Irrigated in whole or in part.....	\$ 6,741,000
Average Size Irrigated Farms.....Acres,	27
Average Size Irrigated Farms of 160 acres and upward.....	313
Percent of Acreage of Irrigated Farms, 160 acres and upward, to Total Irrigated Acreage.....	9.81%
Average Size Farms under 160 Acres.....Acres,	25
Average 1st Cost Water-right per Irri- gated Acre,	\$10.55
Average Annual Cost Water per Irri- gated Acre,	Co-operative Plan. .91
Average Cost Preparation for Cultiva- tion per Irrigated Acre,	\$14.85
Expenses of Irrigator.....Capitalistic Plan	\$36.00
Average Value of Irrigated Land, in- cluding Buildings, etc.....Co-operative Plan....	\$84.25
Average Value of Irrigated Land, in- cluding Buildings, etc.....Capitalistic Plan	\$92.50
Average Annual Value Product per Ir- rigated Acre.....Co-operative Plan....	\$18.03
Average Annual Value Product per Ir- rigated Acre.....Capitalistic Plan	\$37.00

¹ Compiled from statistics furnished by Joseph P. Bache, State Statistician. Average yields and acreage under cultivation verified by Year Book of the Department of Agriculture, 1895, 527-31.

TABLE No. 2.
SHOWING UTAH'S RANK WITH OTHER STATES AND TERRITORIES OF THE ARID REGION (1890).¹
GENERAL STATISTICS AND REVENUES.

States and Territories.	Number Irrigators.	Acreage Irrigated.	Per cent Land Surface Irrigated.	Per cent number Farms Irrigated.	Per cent Land in Farms Irrigated.	Irrigated Acreage Unit.	VALUE IRRIGATED FARMS. Average Value per acre.	Total Value.	VALUE PRODUCT. Average Total Value.
Arizona.....	1,075	65,821	.09	75.39	43.21	61	\$ 48.68	\$ 3,204,000	\$13.92 \$ 916,000
California....	13,732	1,004,233	1.01	25.96	17.86	73	150.00	150,635,000	19 00 19,080,000
Colorado.....	9,659	890,735	1.34	58.94	31.09	92	67.02	59,696,000	13.12 11,686,000
Idaho.....	4,323	217,005	.40	65.47	26.08	50	46.50	10,091,000	12.93 2,806,000
Montana.....	3,706	50,582	.38	66.14	23.05	95	49.50	17,354,000	12.96 4,544,000
Nevada.....	1,167	224,403	.32	91.39	14.13	192	41.00	9,200,000	12.92 2,899,000
New Mexico..	3,085	91,745	.12	69.20	17.98	30	50.98	4,677,000	12.80 1,174,000
Oregon.....	3,150	177,944	.39	31.01	15.89	56	57.00	10,143,000	13.90 2,473,000
Utah.....	9,724	263,473	.50	92.46	22.03	27	84.25	22,198,000	18 03 6,950,000
Washington..	1,046	48,799	.22	9.78	17.00	47	50.00	2,440,000	17.09 834,000
Wyoming...	1,917	226,676	.37	61.34	15.24	120	31.40	2,440,000	8.25 1,895,000

This table shows that Utah stands next to California in the number of irrigators, and is exceeded by only 3 States in the area of the land irrigated. In size of farms, 27 acres, it stands at one extreme, while Nevada, with 192, is at the other. This minute division of the irrigated lands in itself testifies to a relatively large amount of care bestowed upon each area, and signifies that there should be a correspondingly large average value of products, as is the case, the average value \$18.03 being second only to that of California. It would have been first, were it not that in California the average value of products is increased by the cultivation on a large scale of the highest class of fruit. In percentage of entire land surface irrigated and in the relative proportion of the farm area irrigated, Utah stands next to Colorado and California, and in percentage of total number of farms irrigated is first, with the remarkable percentage of 92.46 per cent. In both the average acreage value and the total estimated value of the irrigated farms and in the total estimated value of the farm products, Utah ranks second to California.

¹ Compiled from Eleventh Census, Agriculture by Irrigation, F. H. Newell. In 1894, the number of irrigators in Utah was 11,427; the acreage irrigated, 417,455; the total value of the irrigated farms, \$42,164,688. Accurate figures showing the status of irrigation in other States and Territories in 1894 could not be obtained, hence a comparative study could only be based on the census year.

TABLE No. 3.
SHOWING UTAH'S RANK WITH OTHER STATES AND TERRITORIES OF THE ARID REGION (1890).¹

States and Territories.	EXPENDITURES.		Average Average Cost of Preparation for Cultivation.
	Average First Cost Water-rights per Acre.	Average Annual Cost Water per Acre.	
Arizona	\$7.07	\$1.55	\$8.60
California	12.95	1.60	17.48
Colorado	7.15	.79	9.72
Idaho	4.74	.80	9.31
Montano	4.63	.95	8.29
Nevada	7.58	.84	10.57
New Mexico	5.58	1.54	11.71
Oregon	4.04	.94	12.59
Utah	10.55	.91	14.85
Washington	4.03	.75	10.27
Wyoming	3.62	.44	8.23

As Utah is second to California in the revenues accruing from the irrigated farm, so it is second in expenses incurred. The large first cost of water-rights on an irrigated farm is rather to be desired than deprecated, because it indicates that durable works are annually constructed for saving and distributing water. The share, either in money or labor, expended by the Utah laborer in keeping his ditches in repair, *i. e.* the average cost of water per acre, is a mean of all the States and Territories. The cost of repairing is higher in Utah than in such a State as Wyoming, where ditches really need more repairing, because in Utah this item not only covers the cost of keeping the canal in repair, but also pays interest on the investment, salaries of officers and other items of expense.

The high cost of preparation for cultivation is to be attributed to the immense amount of fencing that is done in Utah, rather than to a rough and uneven configuration.

¹ Compiled from Eleventh Census, Agriculture by Irrigation, F. H. Newell.

TABLE NO. 4.
SHOWING IRRIGATED FARM INDEBTEDNESS AND EXPENDITURE (1894).¹

Counties.	Total No. Farms.	Number Farms free of Incumbrance.	Number Farms Mortgaged.	Amount Mortgages.	Average rate of Interest.	Expended for Buildings.
Beaver	373	359	14	\$10,505	19½%	\$20,905
Rox Elder	799	701	98	109,920	10½	67,843
Cache	3,842	3,469	373	296,134	10½	14,862
Carbon	108	103	5	4,800	9	45,435
Davis	879	741	138	165,863	8½	22,179
Emery	552	523	29	17,475	8½	21,228
Garfield	512	500	12	7,845	15	14,570
Grand	112	107	5	7,100	11	14,353
Iron	346	342	4	2,750	10	20,094
Juab	320	283	37	45,975	10¾	6,933
Kane	238	238				67,660
Millard	470	420	50	57,717	13	8,532
Morgan	350	300	50	28,334	10	10,152
Piute	173	167	6	5,400	12	65,405
Rich	269	229	40	68,830	9	4,005
Salt Lake	2,195	1,889	306	354,550	10	73,804
San Juan	44					35,050
San Pete	1,540	1,334	206	138,549	11	15,175
Sevier	(a)		(a)	37,446	12	11,690
Summit	576	536	40	34,063	10	21,797
Toelle	517	462	55	35,892	10	81,912
Uinta	443	429	14	6,490	14¼	30,651
Utah	2,751	2,394	357	295,526	10¾	7,940
Wasatch	515	462	53	35,959	13¾	29,907
Washington	482	480	2	6,120	10	
Wayne	(a)		(a)	400	(a)	
Weber	1,175	941	234	197,909	8¼	
Total	20,581	17,453	2,128	\$1,971,352	11	\$718,929

(a) Not reported.

This table, compiled from returns from 25 of the 27 counties of the State, shows 89.1 per cent of Utah's irrigated lands free from incumbrance; 10.9 mortgaged. The average amount of mortgage per farm incumbered is \$908.60. Two of the 27 counties in the State have not a single mortgaged farm, and 8 counties have less than 15 mortgaged farms between them. In the Middle Western States of Illinois, Iowa, Missouri and Kansas the percentage increases to nearly 40 per cent. This is a significant tribute to the land of the small irrigated farm.

¹ Compiled from statistics furnished by Joseph P. Bache, State Statistician.

CLASSIFICATION IRRIGATED FARMS ACCORDING TO TENURE (1894).¹

	Total No. Irrigated Farms. 20,581.	CLASS I—Cultivated by OWNERS.	CLASS II—Rented for fixed Money Rental.	CLASS III—Rented for Shares of Products.
Beaver.....	373	357	6	20
Box Elder.....	799	634	126	39
Cache.....	3,842	3,611	80	151
Carbon.....	108	93		15
Lewis.....	879	853	21	5
Emery.....	552	525	5	22
Garfield.....	512	488	17	7
Grand.....	112	104		8
Iron.....	346	312	8	26
Juab.....	320	320		
Kane.....	233	229		9
Millard.....	470	440	30	
Morgan.....	350	347	1	2
Piute.....	173	156	5	12
Rich.....	269	244	19	6
Salt Lake.....	2,195	1,980	83	132
San Juan.....	44	44		
San Pete.....	1,540	1,495	38	7
Sevier.....	(a)	(a)		
Summit.....	516	560	8	8
Toelle.....	517	472	42	
Uinta.....	443	426	1	16
Utah.....	2,751	2,501	13	37
Wasatch.....	515	493	57	17
Washington.....	482	479		3
Wayne.....	(a)	(a)		
Weber.....	1,175	968	35	172

(a) Not reported.

This table shows that 88.1 per cent of the irrigators of Utah own their own lands and homes, while in the United States 52.2 per cent of the farmers hire their farms and houses. In the representative Southern States of Mississippi and Georgia the number of farmers who own and cultivate their own land is only 56 and 56.1 per cent respectively; while in the wealthy State of Pennsylvania only 78.8 per cent of the economical Quakers have a tenancy in fee simple. It is a significant fact that the farmers within the States and Territories of the arid domain are credited with the most substantial tenancies in the United States.

¹ Compiled from statistics furnished by Joseph P. Bache, State Statistician.

TABLE No. 6.
SHOWING LABOR AND EXPENSES ON IRRIGATED FARMS (1894).¹

Counties.	Number Laborers hired.	Amount paid Laborers.	Expended for Repairs.	Expended for Fertilizer.	Expended for Taxes.	Sundry Expenses.
Beaver	260	\$29,771	\$17,823	\$2,126	\$5,293	\$4,996
Box Elder	221	44,424	11,733	620	27,403	2,135
Cache	240	47,812	15,654		79,895	92,604
Carbon	96	29,435	5,580		1,659	6,053
Davis	416	45,885	16,800	1,825	42,261	41,740
Emery	64	14,746	4,037	4,276	13,697	2,868
Garfield	30	21,464	5,436	1,976	6,025	2,115
Grand	42	11,784	3,047		1,537	3,782
Iron	108	13,702	2,700	2,774	1,603	5,190
Juab	170	29,840	5,565	5,607	8,356	4,303
Kane	27	8,920	1,160	757	1,720	720
Millard	259	44,552	9,163		1,692x	13,646
Morgan	(a)	(a)	5,184	360	7,554	2,910
Piute	81	18,400	(a)		(a)	(a)
Rich	200	30,002	6,286	2,219	10,856	(a)
Salt Lake	607	90,168	20,360	4,346	89,386	21,778
San Juan	65	15,810	682		1,886	1,507
San Pete	768	205,512	25,239	13,101	60,051	12,937
Sevier	420	41,000	(a)		24,930	(a)
Summit	75	29,981	5,462	125	15,120	6,841
Toelle	270	70,493	8,851	256	22,386	14,652
Uinta	91	13,354	9,980		9,132	11,585
Utah	1,052	102,244	23,240	39,798	75,742	17,020
Wasatch	47	8,732	2,192	5,342	15,779	14,989
Washington	(a)	841		7,322	(a)	(a)
Wayne	12	4,815	3,607	6,055	1,358	2,160
Weber	399	43,150	16,257	11,726	70,261	17,614

(a) Not reported.

The general property tax, including tax on real estate and improvements, for Utah in 1896 was \$851,607.76. Of this, \$610,820, or over 70 per cent., was contributed by the irrigated farm.

¹ Compiled from statistics furnished by Joseph P. Bache, State Statistician.

TABLE No. 7.
SHOWING INCREASE IN NUMBER, ACREAGE, VALUE OF PRODUCTS AND IMPLEMENTS OF
IRRIGATED FARMS SINCE 1850.¹

Year.	Number Average Irrig- ated Farms. Acres.	TOTAL LAND IN FARMS.			Value of Irrigated Farms, including Land, Fences, etc.	Value Products of Irrigated Farms.	Value Implements and Machinery on Irrig- ated Farms.
		Improved. Acres.	Unimproved. Acres.	Under Cultiva- tion. Acres.			
1850	926	51	16,333	30,516	14,566	10,300	\$84,288
1860	3,635	25	77,219	12,692	38,187	36,368	242,889
1870	4,908	30	118,755	29,606	64,765	58,936	291,390
1880	9,452	69	416,105	239,419	298,151	25,137	916,753
1890	10,517	27	548,223	775,482	306,043	263,473	1,164,660
1894	20,581	27	806,650	979,182	467,162	417,455	3,640,746

This table tells an almost romantic story of progress, and is a lasting testimonial to the efficiency of irrigation. It shows an increase, within less than half a century, of 2222 per cent in the number of farms, of 4930 per cent in the improved land in farms, of 4030 per cent in the amount of irrigated land in farms, of 4470 per cent in the value of the irrigated farms, of 2139 per cent in the estimated value of the annual products of the irrigated farm, and of 4320 per cent in the value of the implements and machinery used on the irrigated farm. The decrease in the size of the farm unit shows that more intensive and less wasteful methods of farming are now being pursued.

¹ Compiled from Seventh, Eighth, Ninth, Tenth and Eleventh Census Reports, and from statistics for 1895, furnished by Joseph P. Bache, State Statistician.

TABLE No. 8.
SHOWING INCREASED PRODUCTION OF PRINCIPAL CROPS IN UTAH SINCE 1850.¹

Year.	Wheat. Bushels.	Corn. Bushels.	Oats. Bushels.	Barley. Bushels.	Rye. Bushels.	Potatoes. Bushels.	Hay. Tons.
1850.....	107,702	9,899	10,900	1,799	210	44,020	4,805
1860.....	384,892	90,482	63,211	9,976	754	141,001	19,235
1870.....	538,473	95,577	65,650	49,117	1,312	323,808	27,305
1880.....	1,169,199	163,637	418,082	217,140	9,605	573,595	92,735
1890.....	1,515,464	85,020	597,947	163,328	33,928	519,720	301,901
1897.....	3,190,740	186,494	838,355	183,520	42,696	783,304	540,396

¹ Compiled from the Seventh, Eighth, Ninth, Tenth and Eleventh Census Reports, and from statistics for 1897, furnished by Mr. John Hyde, Chief of the Bureau of Statistics, Department of Agriculture.

TABLE No. 9.
SHOWING AVERAGE ACREAGE YIELDS FOR CERTAIN REPRESENTATIVE STATES AND THE UNITED STATES, AND THE AVERAGE, IRRIGATED AND DRY FARM YIELDS FOR UTAH (1897).¹

	Wheat, Bushels.	Corn, Bushels.	Rye, Bushels.	Oats, Bushels.	Barley, Bushels.	Potatoes, Bushels.	Hay, Tons.
California	10	31.5	12.2	18.	23.	105	1.60
Georgia	9.4	11	7.4	14	(a)	52	1.35
Ohio	16.9	32.5	18	32	28.5	42	1.44
New York	21.4	31	18.5	31	25	62	1.35
United States (Average).....	13.4	23.8	16.1	27.2	24.5	64.7	1.43
Utah (Average).....	21	22	12	35	31	148	2.95
Utah (Irrigated).....	40	22	25	35	48	148	3.5
Utah (Dry-Farmed).....	15	Requires Irrigation.	8	Require Irrigation.	12	Require Irrigation.	1

¹ Acreage yields for States and the United States are compiled from statistics furnished by Mr. John Hyde, Chief of the Bureau of Statistics. The comparison of irrigated and dry-farmed yields in Utah is based on statements submitted by representative Utah farmers.

TABLE No. 10.
SHOWING ACREAGE, PRODUCTION AND VALUE OF PRINCIPAL CROPS IN UTAH, FOR 1897.¹

Crops.	Acreage, Acres.	Production, Bushels.	Value.
Wheat.....	151,940	3,190,740	\$2,169,703
Corn	8,477	186,494	102,572
Oats.....	23,953	838,355	276,657
Barley	5,920	183,520	82,584
Rye	3,558	42,696	25,618
Potatoes.....	5,293	783,364	235,909
Hay	183,185	540,396 Tons.	2,566,881

¹ Compiled from statistics furnished by Mr. John Hyde, Chief of the Bureau of Statistics.

84 *The Economic History of Irrigation in Utah.*

Having given a general outline of agriculture in Utah, special crops will be considered with reference to their yields and quality.

The principal product of Utah in point of acreage under cultivation is wheat. In 1889 the *American Agriculturist* offered a prize of \$500 to the farmer who raised the largest crop of wheat in the United States. The prize was won by William Gibby, a farmer of Salt Lake City, who raised 4806 pounds of clean wheat, or 80.1 bushels, from an irrigated acre of ground accurately surveyed.¹ The crop came up in the middle of February and received no attention until the first of April, when it was rolled once. No other care was given it until harvest time, and the prize acre received no different treatment than the general wheat crop on the farm, the entire yield of which averaged 70 bushels per acre. The average yield per acre from irrigated lands in Utah is 40 bushels, while the average wheat yield per acre for the United States is only 13.4 bushels. In eleven of the twenty-seven counties of Utah yields were reported last year as high as sixty bushels per acre. The following table shows the yield in bushels per acre in several representative States and the United States at large over a period of six years:²

State.	1891.	1892.	1893.	1894.	1895.	1896.	Average.
Utah	17.5	17.3	13.8	22.0	22.4	26.5	19.9
California	13.0	13.0	13.3	11.3	13.0	14.5	13.0
Colorado	20.2	19.1	13.2	17.8	23.5	18.0	18.6
Ohio	17.1	13.6	14.5	19.0	13.3	9.0	14.4
New York	16.6	16.2	14.5	14.8	18.1	15.0	15.8
United States . . .	15.3	13.4	11.4	13.2	13.7	12.4	13.2

These are the average yields from irrigated and non-irrigated farms, and from good, bad and indifferent farming. They show, however, that Utah farms, dry and irrigated

¹ Report of the Utah Irrigation Commission to Third National Irrigation Congress, Denver, 1894, 67.

² Compiled from the Year Books of Dept. Agriculture, 1891-96.

together, produced during the past six years just 50 per cent more wheat per acre than the average of all the States of the Union, and 35 per cent more per acre than the great wheat-growing State of Ohio. That the quality of Utah wheat is superior may be judged from the awards it received at the World's Fair and the Sioux City Corn Palace. Firm and plump, and with an exceptionally large kernel, it makes good flour and finds a ready market. Although the annual yield is large in proportion to Utah's population of less than 250,000, the home market readily absorbs it all. The consumption is $6\frac{1}{4}$ bushels per capita.¹

The average yield of oats per irrigated acre in Utah is 35 bushels. Instances are not infrequent where from 60 to 85 bushels per acre have been harvested. This cereal, as it is raised in Utah, is heavy and full of meat, always commanding a good market and furnishing a good acreage return. It is in considerable export demand, being a prime favorite with oatmeal mills in the Middle States, where it is manufactured into a high class quality of rolled oats.

Utah barley, which averages 48 bushels per irrigated acre, is a very thin-skinned variety. The white-club barley is extensively grown for brewing, and is in demand throughout the East in competition with the best Canadian.

Until 1890 comparatively little rye was raised in Utah, but within recent years there has been a powerful impetus to its cultivation, its yield having increased from 33,928 bushels in 1890 to 42,696 bushels in 1897. The average yield of rye per irrigated acre in Utah is 25 bushels.

Corn requires hot sultry nights for its cultivation, so the cool nights characteristic of Utah are not favorable to large crops. Despite this, the average yield per irrigated acre is 22 bushels.

As wheat is the premier crop in point of acreage under cultivation, so alfalfa or lucerne is the premier crop in point of valuation. It would not be an exaggeration to say that of all the grasses grown in this country none give such

¹ First Triennial Report of State Statistician, 1895, 6.

satisfactory yield and are cultivated with less expense than alfalfa. Grown on rough ground too dry for grass and too broken and stony for grain, alfalfa yields three crops a season without a re-sowing, requires only five pounds of seed to cover an acre; and besides an annual harvest in hay of 7 tons per irrigated acre worth \$5 per ton, yields 600 pounds of seed per acre, worth \$20. A conservative estimate of the expense of planting and cultivating an acre of alfalfa is \$2, leaving a net profit to the producer of \$53 per acre. Besides possessing an inherent market value, alfalfa is a great fertilizer and enricher of the soil, redeeming worn-out land so that in a few years it can be used for grain. Other forage grasses that flourish on the irrigated lands of Utah are clover, timothy and red-top, which cure and retain their nourishing qualities better than anywhere else, owing to the dry atmosphere. Statistics show an average of 3.5 tons per irrigated acre.

As wheat leads in acreage under cultivation and alfalfa in the value of the yields, so potatoes lead in the size of the yield per acre. On irrigated lands 148 bushels is the average yield, while on "dry farmed" land potatoes cannot be raised at all. There is an exceptional case on record where 1107 bushels were raised from one acre of irrigated land.¹ The writer personally knows a prominent irrigator in Weber county who raised 1100 bushels of potatoes to the acre in 1890, which at the market price at that time netted him \$550. The cost for seed and planting did not exceed \$5.² As to quality, the Hon. Jeremiah Rusk once said that "Utah potatoes beat the world." They are soft and mealy and grow to a size that other States have tried in vain to match.

One of the most profitable fields for the investment of the irrigator's labor is the raising of beets for the manu-

¹ This extraordinary showing was made in 1894 on the farm of J. A. Bigeler, of Boxelder County.

² This statement was made to the writer by L. B. Adams, Weber County.

facture of sugar. The annual consumption of sugar in the United States is 72 pounds per capita, representing a total of more than 5,000,000,000 pounds for seventy millions of people. Of this only one-fifth is produced at home, more than \$100,000,000 worth of sugar being imported each year to meet the deficiency in our home supply. Confronted with these conditions and assured that the demand for sugar in the home market was such as to make the production of sugar from beets profitable, in 1890 a sugar factory was started on the co-operative plan at Lehi, Utah county, at a cost of over \$500,000. When the factory was established to manufacture sugar from beets the idea prevailed that artificial irrigation would never produce sugar. Professor Wiley, of the Department of Agriculture, voiced the prevalent sentiment when he declared, "There is no crop within the whole range of agriculture more difficult to produce than a crop of beets for the manufacture of sugar."

In spite of these pessimistic predictions, the Lehi factory has attained a success during the four years of its existence which has more than justified the hopes and expectations of its projectors, and has opened the way for solving the problem of supplying home demand by Utah-made sugar. The company is stoutly capitalized, has a \$500,000 plant, and is equipped to handle daily 350 tons of beets and for turning out 40 tons of refined sugar. An inkling of the extent of the operations of this factory can be had from statistics furnished by its manager, Thomas C. Cutler, who says: "During 1896 we sliced nearly 40,000 tons of beets; and paid out for labor, beets, fuel and manufacturing material \$276,750, every possible cent of which was paid to Utah farmers, Utah merchants and Utah operators; it was all spent at home except for such material as could not well be purchased in the State." A circular issued by the sugar company urges farmers to grow sugar beets, and offers to pay \$4.30 per short ton of beets delivered to the factory. When it is considered that the average yield of beets per irrigated acre is 12.68 tons, and that the average acreage

88 *The Economic History of Irrigation in Utah.*

value is \$54.55, it will be seen what a lucrative field for investment is open in this direction. Sugar-cane is also a good crop in Utah, an irrigated acre averaging 20 gallons of sorghum. In 1894, 90,201 gallons of sorghum were manufactured from sugar-cane grown on 4510 acres.

Farming on the small scale of a twenty-seven acre unit has naturally led to an extensive cultivation of garden truck. Large quantities of cabbage, cauliflower and celery are annually exported. To instance the possibility of celery cultivation in Utah, the Bear River Irrigation Company, on its experimental farm west of Corinne, netted last year from a single irrigated acre of celery, \$800.

Table Showing the Average Yield of Garden Produce per Irrigated Acre and the Average Market Price.¹

Vegetable.	Average Yield.	Price.	Total.
Lettuce.....	14,000 heads.	\$.02 per head.	\$280.00
Early Cabbage....	12,000 "	.05 "	600.00
Early Cauliflower.	7,260 "	.10 "	726.00
Onions.....	600 bushels.	.75 per bushel.	450.00
Parsnips.....	1,800 "	.25 "	360.00
Carrots.....	1,800 "	.20 "	360.00
Tomatoes.....	2,250 "	.40 "	900.00
Potatoes.....	150 "	.75 "	172.50
Large Peas.....	306 "	1.00 "	306.00
Small Peas.	200 "	1.25 "	250.00
Green Beans.....	400 "	.90 "	360.00
Cucumbers.....	250 "	.50 "	125.00
Asparagus.....	5,500 lbs.	.08 per lb.	440.00
Rhubarb.....	7,000 "	.015 "	105.00
Corn.....	2,420 dozen.	.10 per dozen.	242.00
Celery.....	30,000 "	.03 per stk.	90.00

Besides the staple crops and the garden produce already mentioned, flax, hops and cotton are grown in limited quantities in Utah.

¹This table is attested by Ephraim Briggs and Brigham Holbrook of Bountiful, Davis Co., Utah.

CHAPTER VIII.

DEVELOPMENT OF HORTICULTURE THROUGH IRRIGATION.

Profitable as has been the pursuit of every branch of husbandry in Utah, horticulture has easily taken the lead when the acreage under cultivation is considered. This is seen by comparison of the average money value of cereals per acre with the average money value of fruits per acre. In 1894 the average acreage value of cereals in Utah was \$10.13, while for the same year the average acreage value of fruit was \$32.15.¹

Whatever success has been achieved along horticultural lines in Utah may be wholly attributed to irrigation; because fruit trees, even more than agricultural produce, require a certain amount of watering at particular seasons of the year. Utah soil is peculiarly favorable to the cultivation of orchards. It is charged with calcium phosphate and carbonate of lime, both essentials to the raising of good fruit; while the granite, feldspar, porphyry and limestone brought down from the mountains in the canyon streams contain an excess of plant food. Within the past six years the farmers of the State have been quick to realize the inducements which a rich soil, a certain water supply and a ready market have offered for the cultivation of fruit, so that to-day to every farm there is attached an orchard.

However, when the opportunities for profit are considered, it must be admitted that horticultural development in Utah has been a slow process. Although the orchard products of the pioneers were of an excellent quality and of great variety, poor transportation facilities restricted the range of production to home consumption. And even after

¹ First Triennial Report of State Statistician, 1895.

the railroads were built, little of Utah fruit found its way to eastern markets, because the mines afforded a ready sale for the surplus and little thought was given to orcharding in a commercial sense. The successful experiments of the pioneers demonstrated the adaptation of the country to the production of the most perfect fruits. Unfortunately the situation was not appreciated and taken advantage of by their successors, for until the past five years there were scarcely a dozen commercial orchards planted in Utah. Content to follow in beaten paths, the farmers planted perhaps twenty trees of an equal number of varieties, with the result that too much was produced for family use and the immediate markets, but not enough to justify a shipment to the distant centres of consumption. Indiscriminate planting and lack of facilities to properly preserve the surplus fruits were the two great drawbacks to the fruit industry with the present generation.

During the last six years, however, there has been a marked awakening in the field of horticulture. The causes operating to produce this activity have been: (1) Booms in the principal cities of Utah, causing many investors to invest in suburban fruit orchards. (2) A growing demand for Utah fruits in European and American markets. (3) The dissemination of valuable information regarding the methods of fruit-raising by the Agricultural College at Logan. (4) The appointment of a Horticultural Commission, consisting of one member from each county, for the purpose of encouraging progressive methods of culture, packing, storage and preservation of fruit.

Table showing the increase in bushels in the yields of the principal fruits since 1890:¹

Year.	Apples.	Peaches.	Pears.	Plums.	Apricots.
1890	56,633	69,910	6,198	9,663	4,178
1895	377,935	154,772	27,261	37,810	21,234

¹ Compiled from Eleventh Census Report and First Triennial Report of State Statistician, 1895.

Development of Horticulture through Irrigation. 91

This shows an average increase in fruit production within five years of 410 per cent.

Within the past five years more than \$3,000,000 have been invested in the reclamation of land more or less suited to fruit-growing. In the Bear River Valley more than 100,000 fruit trees have been planted.¹ The Mount Nebo Company has opened up a large body of fruit lands and planted about 15,000 trees. Throughout the State farmers are awakening to the fact that fruit-growing will yield a larger revenue than derived from grain or hay, and, accordingly, systematic planting is going on. Profiting by the lessons of the past, great care is being exercised in the choice of varieties and the number of trees of each kind wanted.

With this widening in the range of production there has come demoralization in fruit exchanges. Utah, like California, is hampered by the commission system.² While the prices of all fruits in the home market have been good, in eastern markets the producer has realized practically nothing for his shipments. The low prices received by the producer have been popularly attributed to three causes, viz., (1) over-production, (2) under-consumption, and (3) dishonest commission houses.

The commission merchant urges that over-production is the trouble. He says that the planting of fruit trees has been stimulated to abnormal proportions, that because a few individuals have realized great profits and the average grower has received very fair prices, there has been an unnatural impulse to the planting of orchards, and hence over-production and a decline in prices. Others advance the substantial theory of under-consumption, stating as the major premise in their syllogism that American consumption of fruit is far below the standard set by the Old World.

But the writer is inclined to believe that the crux of the

¹ J. A. Wright, *Horticulture in Utah* (art. in *Salt Lake Tribune*, Jan. 1, 1897).

² For a discussion of the commission system, cf. art. in *Irrigation Age*, Feb., 1894, entitled, "A Policy for Fruit Growers."

whole matter lies in the fraudulent dealings of the commission houses with the growers. The commission house occupies the wide space between the producer and the consumer. It has grown to be a large and important part of the machinery of the fruit industry. It represents a comparatively small investment, yet bears every evidence of having enjoyed a disproportionately large share of the profits. "Let me control the market and I care not who raises the fruit" is an old adage that may be applied to the commission house. Whoever controls the market is certainly in a position to make the business net a profit or a loss to the scattered and unorganized class who raise the fruit and whose aggregate investment in the business is enormous. It is the custom of commission houses to make contracts under which they advance money on the crop and then agree to handle it at the owner's risk, disposing of it according to their judgment and returning the proceeds of the sale to the grower, less expense of handling and commission. It is charged, and there is good reason to believe, that fruit is often sold to purchasers who are merely the "go-betweens" of the commission men, and that the genuine sale to wholesaler or retailer is made on much better terms, the profit on the transaction going into the pockets of the commission men. The writer in a subsequent part, entitled "Problems of Irrigation in Utah," will advance the theory that the system of co-operation which has so successfully tided the small producer over the evils of monopoly should regulate his fruit exchanges—in a word, that individual producers should band together and become agents for the collective whole.

Having briefly sketched the history of horticulture, the variety and yields of its fruits will be discussed in detail. The staple fruit crop of Utah is apples. While every variety, ranging from the tenderest pippin to the hardest crab, is grown, the tendency is to limit the assortment in the commercial orchards to such standard varieties as the Ben Davis, Rhode Island Greenings, Jonathan, Wine-sap, Spitzenberg, Wealthy and York Imperial. It has been

estimated by conservative Utah horticulturists that a ten-year old apple tree yields from seven to twelve bushels of fruit each year, worth at harvest time \$0.40 per bushel. Thus at the lowest yield and the lowest price the annual product of each tree is worth \$2.80. As 108 trees are planted to the acre, we have an acreage value of \$302.40. A thoroughly good ten-year old apple orchard represents an acreage outlay of about \$250, thus netting a surplus the tenth year of \$57.40 per acre. After the tenth year the acreage yield is a clear gain.

In pears the range of varieties that succeed in Utah is equally as wide as with apples, and here also is noted the tendency to narrow down to perhaps a half-dozen well-known sorts, including the Bartlett, Flemish Beauty, Kieffer, Anjou, Howell and Winter Nellis, these varieties covering the entire season in which pears may be kept. The average acreage value for 1895 was \$33.40, in this respect ranking fourth among Utah's productions, grapes and beets leading with \$64.54 and \$54.55 respectively. Where pear orchards are carefully tended and scientifically irrigated the yields are phenomenal. There is a case on record in Weber county where a twenty-acre pear orchard in 1896 netted \$8320, or \$416 per acre, after all transportation charges were paid, and for the last five consecutive years this orchard has netted over \$5000.¹

It was Utah peaches that brought fame to the territory when, in early days, the dried fruit was sent by freight teams to the eastern markets. The desirable points of size, color and firmness are universally present, and have made the Utah peach a worthy competitor of the California. The average acreage value of peaches in 1894 was \$45.90.

Plums and prunes are produced in abundance, although up to the present time there has been no effort to grow them for commercial purposes. Not only should the annual production of nearly 40,000 bushels be marketed, but

¹ The orchard in question is owned by Frederick Zeimer of Ogden, Utah.

94 *The Economic History of Irrigation in Utah.*

the example of the Bear River Irrigation Company in establishing evaporating works for prunes should be imitated.

Utah is specially adapted to the raising of cherries, a fruit requiring regular waterings and great care for the first five years after planting. The best varieties are the Napoleon, Black Republican and Royal Anne. When it is considered that cherries cannot be raised in the country between the Rocky and Allegheny mountains, it will be seen what an opportunity for export is presented to Utah irrigators.

The late frosts make it possible to grow on the irrigated lands of Utah the choicest California grapes, which bring a better price to the grower by reason of saving the expense of a shorter haul, Utah being two days nearer eastern markets than Pacific Coast points are. The average acreage value of grapes in 1894 was \$64.50, showing that grapes are by far the most profitable fruit raised in Utah.

That small fruits do well in the new State is seen from the following statement made by A. L. Buckland, of Davis county, relative to yields on his irrigated farm in 1894:

Watermelons, per acre 862 dozen.
Cantaloupes, per acre 1814 dozen.
Downing gooseberries, per acre.... 800 bushels.

Table showing average yield and average prices of Utah's fruit:¹

Apples per tree,	7 bushels	\$.40 per bu.	(108 trees, acre.)
Pears "	5 "	.70 "	(100 ")
Peaches "	4 "	.65 "	(108 ")
Plums "	10 cases	.35 per case	(108 ")
Cherries "	6 "	.80 "	(108 ")
Black Apricots,	5 "	.60 "	(108 ")
Watermelons,	500 doz. per acre	.40 per dozen.	
Cantaloupes,	1250 " "	.60 "	
Gooseberries,	200 bu. "	1.00 per bushel.	
Currants,	827 lbs. "	.03 per lb.	
Grapes,	1500 " "	.03 "	

¹ These statistics were furnished the writer by James A. Wright, President Utah State Board of Horticulture.

Development of Horticulture through Irrigation. 95

Table showing acreage, yield and value of Utah's fruit in 1894:¹

Fruits.	Acreage.	Products.	Value.
Apples	6698	377,935 bu.	\$146,764
Pears	564	27,261	18,832
Peaches	1636	154,772	75,152
Plums	852	37,810	19,835
Apricots	351	21,234	10,372
Grapes	578	1,046,768 lbs.	37,263
Small fruits	747	618,317	12,253

¹ These figures were furnished by Joseph P. Bache, State Statistician.

CHAPTER X.

RELATION OF IRRIGATION TO OTHER FACTORS OF UTAH'S INDUSTRIAL SYSTEM.

A history of the commercial factors in Utah's industrial system shows how intimately related their expansion has been to the progress of irrigation.

Home production for home consumption has always been the underlying principle of the factory as well as the farm, and it was irrigation that made this possible. An increase in the raw material which the irrigator has supplied the artisan has been followed by an increase in the value of Utah's manufacturing products from \$291,223 in 1850 to \$6,678,118 in 1894.

Too poor to purchase the necessities of life which a non-competitive system of railroading had made veritable luxuries through exorbitant freight rates, the hardy Utah prospector depended on the food supply raised on the irrigated bench land to furnish him strength in drilling the mountain rocks. As the products of the irrigated farm increased and cheapened the food supply, the risk incurred in the miner's speculation decreased and thereby widened the sphere of that industry, whose products in gold, silver, copper and lead in 1894 were valued at \$11,631,402.72.¹

In planning the route of railways, the largest traffic was found in the settlements having for their mainspring of commercial activity the irrigation canal. As these settlements increased in number, and better economies were introduced in the diversion and distribution of their water supplies, there was a greater need for transportation facilities for the increased surplus of fruit, grain and garden

¹ First Triennial Report of State Statistician, 1895, 23.

produce. To-day splendidly equipped railroads, with feeders extending in every direction throughout the State, attest the heavy traffic in agricultural exports and imported merchandise purchased with the surplus of the irrigated farms. Not only has this surplus increased as the land has become more intensely cultivated and better watered, but the small irrigation unit has tended to so diversify the irrigator's labors that cheese, butter and milk have become a substantial part of his annual income. It has been estimated that a cow fed on green alfalfa will produce fifty pounds of butter for each ton fed, and there is reason to believe this when it is considered that in 1894, 60,595 milch cows netted their owners 3,441,732 pounds of butter and 820,747 pounds of cheese, besides milk enough to pay for their keeping.¹

The luxuriant growth of grasses, cultivated and developed by a system of irrigation, has encouraged the extension of the ranch and range interests of the State. Immense herds and flocks feed in spring on the native bunch grass of the bench lands; in the summer, graze among the grassy valleys of the mountains; while in winter they gradually retire to the low, wide ranges, where they cannot exist in summer because of the heat and scarcity of water. The share of the wool-growers in supporting a home market for the absorption of the products of the irrigated farm will be appreciated when it is known that the annual value of the clip exceeds \$850,000,² and in years in which there was a protective tariff on wool the clip has been rated at over \$1,000,000.

Land entries having been filed each year and ranches having increased in size and number,³ more attention has been given to the raising of beef for home consumption. This has had an appreciable effect on the money value of

¹ First Triennial Report of State Statistician, 1895, 17.

² The total value of the wool clip in Utah in 1895, at the rate of 7½ cents per pound, was \$864,260.

³ Land entries under the Homestead Act have increased from 6,388, covering an area of 844,159 acres, in 1884, to 11,074, covering an area of 1,408,950 acres, in 1895.

exported agricultural commodities, inasmuch as imported beef has heretofore eaten up a large share of the value of Utah's irrigation surplus.

Taught in the primal system of colonization that good farming was not confined to the production of the necessities of life, the independent landlord of the twenty-seven acre farm has always had a surplus on hand exchangeable for money or some other form of property. When the national currency was a curiosity in Utah the surplus crop was exchanged for Church scrip. This scrip, while not legal tender beyond the confines of the State, possessed purchasing power at the most reliable co-operative stores, and until recently was easily convertible into money. Thus it will be seen that the power of capital and the wise economies of banking have always been recognized in Utah, even in that stage of its history when co-operative labor dominated its industries.

When railroads were introduced and it became profitable to export the surplus crop to eastern markets and receive either articles of eastern manufacture or national currency in exchange, foundations were laid for heavy stock for the shelves of stores and substantial deposits for the vaults of banks. Promoted through the agency of that system of commercial co-operation introduced into the territory in 1868, patronized by an energetic and prosperous people, who annually demanded an increased supply of staples, stores whose original capital was the surplus of the irrigated farm have grown in number and size and extended their branches to every enterprise within the corporate limits of a canal community.

Production has been so diversified and the fixed expenses of the irrigator have become so small that the Mormon farmer has not been compelled to wait until his crop was harvested to redeem his credit with the merchant. Unlike the "one-crop farmer" of the South, he has been enabled to pay cash as his wares were purchased, thus securing cheap cash prices and not endangering the business status of his merchant through forced extension of credit. With

increase in the size of the surplus crop the irrigator has so enlarged his ability to trade that retail houses of but a few years ago have been transformed into immense wholesale and jobbing establishments. In 1894 there were 1974 stores in Utah, with a capital of over \$14,500,000.¹

Intimately related to this extension of commerce and springing from the same source has been the establishment of a co-operative, yet consolidated system of banks, observing all the principles of sound and conservative banking. Carloads of grain, seed, green fruit and vegetables shipped by the irrigators on the co-operative plan soon yielded enough capital to the shippers to found banks with strong specie reserves. Diversified irrigation furnished such elastic conditions of trade that an elastic system of note issue was easily maintained. As the crop surplus increased the deposit became larger, so that to-day the deposits exceed the total capital of the banks of the State by \$4,617,377.² As a proof of the financial steadiness of Utah's banks, it need only be mentioned that during the panic of 1893, when so many banks failed in all parts of the United States, the fifteen banks of Salt Lake and six of Ogden kept open house without even a suspicion of embarrassment. Improved agriculture insured increased surpluses, increased surpluses were convertible into increased deposits, and increased deposits meant increased confidence.

In evolving this system of irrigation, destined to serve as the basis of a superior civilization when its possibilities are fully realized, it has been shown that Brigham Young did not forget that man is a social being and has social needs as well as material wants. He realized that the smaller the farms the nearer the neighbors, the nearer the neighbors the better the social opportunities, the better the social opportunities the higher and nobler the intellectual life. The small farm was made the social as well as the industrial unit.

¹ First Triennial Report of State Statistician, 1895, 19.

² The deposits of Utah's banks for 1895 were \$9,689,267; their capital, \$5,011,890.

CONCLUSIONS.

Arriving in desert solitudes with no available resources save the genius of their leader and the labor of their own hands, toiling with incredible hardihood and persistence against the obstacles confronting them, the Mormon people have built up an industrial system which has stood the test of years and the shocks of adversity. During the eventful panic of 1893, when banks were breaking, factories were closing, and tramps were marching, not a single Mormon bank, factory or store went down. The secret of this prosperity, the warp and woof of this industrial fabric, is scientific irrigation.

There are no droughts, because irrigation insures the crops; there is no hunger, because every man supplies the table from his own labor and his own soil; there are no strikes and lock-outs, because every man works for himself; there are no landlords and no tenants, because every man owns his own home; there are no tramps, because every Utah laborer is not only sure of a good living, but from the proceeds of his surplus crop and the enhancement of his land he acquires in time that competence which is a guarantee of a peaceful old age. The schools, the colleges, the wonderful tabernacle, the temple completed after forty years of labor, at a cost of \$6,000,000, are not the creations of mines, for the Mormons were forbidden to work them. They came not from bonds and mortgages, because labor was the basis of stock in every enterprise. They came from the earnings of labor through the agency of irrigation.

The church historian has prepared a statement designed to show the financial and material results of the policy of Utah irrigation, extending over a period of fifty years.¹

¹ This is a rough estimate, and only purports to set forth general results.

Calculated upon the basis of an average population of 120,000, distributed over 10,000 farms, the expenditures of the Mormon people in cost of living, in public and private improvements, in commercial and church enterprises for the past forty years, have amounted to \$562,900,000, itemized as follows:

Cost of establishing 10,000 farms (\$187.50 per farm per annum)	\$75,000,000
Cost of making irrigation canals and ditches...	15,000,000
Cost of irrigating 10,000 farms and gardens (\$24 each per annum)	9,600,000
Cost of building factories	5,000,000
Cost of building temples	8,000,000
Cost of building churches and schools.....	4,000,000
Cost of missionary work	10,000,000
Cost of immigrating and sustaining the poor...	8,000,000
Living of the irrigators (\$875 per family per annum)	35,000,000
Cost of roads and bridges in mountains and valleys	4,000,000
Cost of Indian wars, building forts, breaking up settlements, etc.	5,000,000
Cost of feeding and clothing Indians, and establishing Indian missions, farms, schools.....	2,000,000
Cost of resisting the invasion of the army of 1857, and of the people of Salt Lake county and the counties north moving south into middle and southern Utah.....	6,000,000
Loss sustained through crickets, locusts, etc...	2,500,000
Unsuccessful early experiments in making iron, sugar, paper, nails, leather, cotton-raising, etc.	6,000,000
Cost of defense against anti-polygamy legislation believed to be unconstitutional.....	3,000,000
Heavy freight rates from the Missouri river and the Pacific coast before railroads were introduced	8,000,000

102 *The Economic History of Irrigation in Utah.*

Cost of establishing the Overland Mail and Express Company, purchase of Fort Bridger, and establishment of Fort Supply, abandoned and afterwards absorbed by the army of 1857.	2,000,000
Protecting overland travel, succoring and feeding California, Oregon and other emigrants..	1,500,000
Cost of colonizing Carson and Green River counties, abandoned because of the army of 1857	2,000,000
Cost of establishing colonies on Salmon river, in Lower California, and the sugar plantation near Honolulu	1,500,000
Cost of local telegraph and railroad lines.....	3,000,000
Cost of obtaining fuel, and building and farming materials, from the rugged mountains and canyons many miles away	10,000,000
Cost of making settlements on the Muddy river, at Call's Landing, Florence, Sunset, and other localities afterward abandoned because of adverse conditions subsequently developed.....	100,000
Losses by fire	800,000
Taxes	8,000,000
Miscellaneous expenditures	12,000,000
Total	<hr/> \$562,900,000

After making the generous allowance of \$20,000,000 for personal property brought into the territory, we find that the Mormons have taken from their farms and workshops the magnificent total of \$542,900,000. In the light of this concrete illustration, it is plain that the industrial system of Utah has sustained the Mormon Church just as the Mormon Church has sustained Utah's industrial system.

To-day the well-tilled farms of the Mormons are furnishing an abundance and paying handsome dividends, while the large tracts of the rain-belt section are being sold for taxes. At a cost of only \$36 per acre, the irrigators of Utah



A MAIN CANAL AND LATERAL.

are constructing and maintaining their own canals, while other people are paying tribute to water monopolies in the form of rentals. They are diversifying the products of their farms to meet the demands for home consumption, while other farmers are impoverishing the soil and glutting the market by raising a single crop. As small producers they are gradually organizing industry and controlling the markets in such a way that the middle-men cannot control the situation and consult only their own interests. They are developing the associated industries to consume the products of their farms, while other producers persist in forming entangling alliances with outside manufacturers. They are reversing the percentage of tenantry prevailing among the industrial workers of the United States and are establishing the economic independence of the family unit. Well do the pioneers of 1847 merit the stately eulogy of Conkling upon Grant, "Great in the arduous greatness of things done."

PART II.

PROBLEMS OF IRRIGATION IN UTAH.

INTRODUCTION.

STATEMENT OF PROBLEMS.

No fair-minded man can look back upon the industrial career of the Mormon people without realizing that their mission in the Arid Region has been important as contributing to a broader settlement and a more advanced industrial civilization. Much has been done, but much more remains to be done.

In general, the primitive methods of irrigation in Utah were haphazard, and projects were carried out with more regard to quick returns than to permanence of works. The ditches were of the simplest character, no provision being made against seepage, nor any for carrying off or diverting surface drainage. The head-works were rude and insecure; no provision was made for storage—in fact, the whole system may be described as crude and wasteful. Even to-day, by far the largest amount of the annual water supply runs to waste, and there is a total loss of the water flowing during the year, except during the two or three months of the irrigation season. When it is considered that water is the essential condition of all values in the arid region, that without it land is practically useless, the conservation of its supply and its equable distribution among the users become vital issues.

The amount of land still susceptible of irrigation, and for which water can be had, is seen from the following table, compiled from the official returns received by the Utah Irrigation Commission:

Total acreage of irrigable lands outside of Indian Reservations	2,304,000
Total acreage of irrigable lands in the Uncompahgre and Uintah Reservations.....	1,350,000
Total	<u>3,654,000</u>
Acreage covered by present ditches.....	1,035,226
Additional irrigable acreage	<u>2,518,774</u>

The 1,350,000 irrigable acres within the Indian Reservations, constituting 37 per cent of the total amount, is in the hands of the National Government.¹

If economic expediency justifies the reclamation of these lands, the question arises, "Who shall formulate the plans and furnish the capital required for the extensive improvements necessary to this end?" Three solutions suggest themselves: (1) That the lands should be reclaimed under the present land laws. (2) That the general government should appropriate money and enter upon the reclamation of the arid lands it holds as an internal improvement. (3) That the lands, situated in the State and now a part of the public domain, should be ceded to the State, either unconditionally or with such conditions and limitations to the grant as would secure those lands to actual settlers in suitable holdings.

More urgent than the problem of State cession is the formulation of an administrative system by which the benefits from the lands already ceded to the State may be enjoyed. In any event, the extension of the policy of State cession would result in agitation as to the best method of enjoying the benefits of the grant. For it is not to be presumed that Congress would transfer to the commonwealths

¹ In 1896, Senator Cannon of Utah introduced a bill providing that the Uncompahgre Reservation be thrown open to public settlement. Because of the existence of asphaltum deposits on the Reservation and a fear on the part of Indian agents lest such an action would be prejudicial to the interests of the Indians, the bill, after passing the House and Senate, was vetoed by President Cleveland. The non-mineral lands of this Reservation were thrown open to public settlement April 1, 1898. No action whatever has been taken looking to the opening of the Uintah Reservation.

of the arid West the 550,000,000 acres of public land now owned by the National Government without duly considering the manner in which the gift would be administered. Three methods present themselves for consideration: (1) Development by the State. (2) Development by public corporations with water districts organized under the laws of the State. (3) Development by private enterprise, operating under grants from the State with proper restrictions imposed upon the grant.

As the area susceptible of irrigation is dependent upon the amount of water flowing in the stream, naturally the fundamental principle underlying any plan of irrigation is to be found in its water laws. A legal definition of all claims to water at a small cost to the owner, a just apportionment of water so defined, and a systematic supervision over the diversion and use of water are questions upon the solution of which will depend the security and value of Utah's irrigation investments. As a remedy for the abuses growing out of the law of priority of right, and as a modification to that law, the writer will recommend State control of water through a Board of Control, composed of a State engineer and representative irrigators from different sections of the State.

This recommendation carries with it the further proposal that an appropriation be made by the next Legislature to defray the cost of accurate measuring devices and the expense of determining the average amount of water required to irrigate lands in different sections of the State.

While water, land, works and management are the prime factors entering into the solution of any irrigation problem, the conditions of the market also determine the success of an irrigation enterprise. Transportation facilities are favorable for the marketing of Utah produce; but, as has been shown in the preceding pages, the markets are organized for the benefits of the dealers rather than the producers. The co-operation of the producers themselves in the shipment of the produce will be urged as a remedy for the evils of the commission system.

CHAPTER I.

ADVANTAGES OF RECLAIMING THE REMAINING IRRIGABLE LAND.

Any discussion of problems arising from the contemplated reclamation of arid land should be prefaced by a consideration of the reasons justifying the economic expediency of such an undertaking. Advantages which make irrigation desirable in Utah apply with equal force to the other States and territories of the arid region; hence, a consideration of the utility of irrigation based on Utah's experience possesses more than a local interest. A review of the economic history of the Mormon people warrants the following conclusions as to the benefits which the reclamation of irrigable lands confers:

First, irrigation promotes better methods of agriculture.

a. By introducing the small farm unit. Whatever the difference is as to water control and administration, all the States and Territories in the arid region have the common tendency of reducing their farm areas.¹ Physical configuration contributes largely to this result. There are so many small areas most valuable for facility and access to water to be found within the inter-mountain region, that subdivision is a necessity. But the real philosophy of the small farm is found in the fact that it introduces elements of certainty in agriculture never known before. There is absolute assurance of harvesting the crop. There is the ability to so widely diversify the products of the farm as to provide almost everything the family consumes. There is the scope for science and intelligence to work out the best possible

¹ The average size of the Utah irrigated farm is 27 acres; the mean average for the Arid Region, 67 acres. Cf. 11th Census, Agriculture by Irrigation, I.

result, and so secure the largest return from each acre and the nearest approach to perfection in quality. Finally, loneliness is banished from country life, because the possibilities of social enjoyment multiply in the ratio of subdivision of area.

b. By fostering intelligent farming. High intelligence and scientific accuracy must be brought into play in the investigation and development of water supply, and in the construction of works for storage and distribution. Irrigation means (1) the power to apply water exactly when needed; (2) the power to apply water in precisely the right quantities; (3) the power to give some one crop water and to withhold it from another; (4) the power to obtain in any year diversified crops in one locality. These requirements are evidences that if the water is to be utilized so as to satisfy the demand of irrigators, scientific methods must be pursued. In short, agriculture and horticulture by irrigation exhibit the same tendency to specialization characteristic of the recent development of all trades and industries. This specialization puts a premium on brains.

c. By encouraging the production of special crops. This follows as a natural corollary from the introduction of the small farm unit. Reclamation of arid lands means not so much a competition with the farmers of other sections as it does the creation of special crops of an important commercial character; accompanied by the formation of home markets, by the necessary development of mines, by the exploitation of salt, onyx and other deposits, by the building of towns and factories, by the construction of railroads, and by the increased importance of the West pastoral and timber industries.

d. By abolishing the autocratic control of water. An important result of irrigation, as practiced in the United States, has been a readjustment of opinions as to the limit of ownership in what may be termed "natural" wealth. The historical law of aridity is beyond question. It is that in every country subject thereto in such a degree as to

require the construction of works, the storage of water therein, and the artificial distribution and application of the same to the soil before cultivation can be made a success, the natural wealth thus created in water must remain public in character, subject to the control of the users and beneficiaries thereof, and be at all times under the administration of law and local authorities.¹

A denial of the quality of personal property in water is a more or less distinctive feature of the jurisprudence of the arid regions. Water not being capable of identification, nor found in place, has none of the elements which legally distinguish property. In ancient times the central or sovereign authority was the autocratic source controlling water supplies for irrigation purposes;² but in the United States the tendency is toward direct State supervision with municipal control and regulation.³ The immediate result of this socialism, as opposed to autocracy, in the use of water has been to prevent conflicts arising between the supplier and applier of water, for in the former case the applier takes as much water as he wants and pays for what he uses.

Second, irrigation through the introduction of improvements in the methods of agriculture promotes commerce and stimulates business.⁴

a. By largely increasing the produce of the land, so reducing the actual labor required to raise a given quantity of the produce. This would be true even if made on the supposition that conservative farmers will for years go on in the same ruts, and after securing water will not otherwise change their practices. However, there is every reason to hope for the passage of such water laws in Utah as will in-

¹ Gould on Waters, Sec. 46-79.

² Justinian's Institutes, 2 Tit. Is., 4.

³ Kinney on Irrigation, Water Rights, Appropriation of Waters, Sec. 54; Bracton, Liber 1, Ch. 22, pp. 7-8; Angell on Water Courses, Sec. 551.

⁴ In the development of this argument, helpful suggestions were received from an address by Donald W. Campbell before the Third Annual Convention of the Nebraska State Irrigation Association. (Cf. Nebraska Annual, 1896, 42.)

crease the duty of water; and, by provision for its more rational use, still further increase the productiveness of the soil.

b. By insuring the crops, and so greatly reducing the risk of capital employed, a risk so great that farmers have become proverbial as weather-grumblers—a natural consequence of seeing their outlay of labor and wages ruined by drought. This insurance by irrigation opens the way for the advancement of agriculture as a business enterprise, lifting it from a precarious investment to a high position as a safe business pursuit. It is safe to say that farmers, as a class, pay higher rates for borrowed money, either on land or on chattel mortgages, than the great majority of other business men. One reason for this is that experience has taught lenders that requests for extension of time in the payment of principal and interest are more numerous on the part of farmer-borrowers than with other classes of borrowers, because their returns are normally subject to more vicissitudes and danger than the average. While this fact may not always be apparent as the reason for the higher rates charged, it is highly probable that the farmer class, as borrowers in an open market, are charged rates which long experience has taught are necessary to cover the risk. It is not possible to believe that discrimination is caused by prejudice, as it is probably true that the great majority of citizens are closely related by blood and friendship to the farmers of the country, and it is also certainly true that money seeks safe investment and will seek the farm, if prompt interest payments can be depended upon.

If the foregoing is true, it follows that the uncertainty of crops is the cause of the evil, necessitating requests for extension of time in meeting obligations; and the more frequent such requests are in any one class of securities, the greater the harm to the credit of that class, and the higher the rates charged on future loans. In short, farming in the rain-belt section is an uncertain business as regards returns for any one year. There is no absolute safeguard against

improvidence, but irrigation comes very near being such a safeguard to the year-by-year farmers. With a certain supply of water the great losses by drought will cease, and the small capitalist will not be taking undue risk when he invests money in labor on land under irrigation.

c. By making intensive cultivation not only possible but preferable, which, it certainly is not where dependence is put upon natural rains. This is because when sure of a crop the investment of more labor and less land will show larger profits. In an irrigated district land rises rapidly in value in consequence of its increased productive power, and the advantages of forcing production are quickly seen by enterprising owners.

d. If intensive cultivation is preferable as a means of obtaining the largest possible returns on the capital invested, it follows that the dwellings of the farmers must be closer together, thereby opening social possibilities now denied to them as a class, and enabling cultivators to act in combination for any public or social purpose. This proposition that intensive cultivation enables farmers to live in a better social environment is a corollary from the third proposition. For with twenty-seven-acre farms 60 to 80 farmers could concentrate their homes in one locality. This concentration of homes would bring social life, with both its pleasures and obligations, to each farmer's door.

Third, irrigation through the creation of business opportunity furnishes a remedy for our industrial ills.

a. By furnishing a new outlet for human energy and thus relieving the congestion of our cities. In 1850 only a little over one-eighth of the population of the United States was in cities of 8000 or more, but so rapid has been the drift of population from the country to the town that nearly one-third of our entire population is now to be found in cities. It is interesting to note how in a single century from 1790 to 1890 the country has lost in percentage of population while the city has gained. In 1790 the urban population was only 3.35 per cent of the whole, while the per cent of the

rural population was 96.65. In 1820 the urban population was 4.93 per cent, and the rural, 95.07 per cent. In 1850, 12.49 per cent of the population was to be found in villages and cities and 87.51 per cent in the country districts. In 1870, 20.93 per cent of the population was to be found in the cities and 79.07 per cent in the country. In 1890, 29.12 per cent of the population was to be found in the cities and only 70.88 per cent in the country.

Not only has the current of population set steadily in the direction of cities, but manufacturing industries have expanded and agriculture has declined. Human genius is already demanding a new field for employment, because the conditions of prosperous activity in all settled countries have been outgrown. Our cities have become the congested slum centers of idle and hungry tenants. They are neither producers in the real sense of the term, nor are they any longer equitable distributors of production. Capital can wait for an adjustment of our economic conditions, but labor cannot. Idleness is danger. Manifestly, the best remedy for the laborless is an opportunity to labor; for the homeless, a chance to earn a home. Forty million surplus irrigable acres west of the Mississippi await the surplus of the 85 per cent of our population crowded east of the Mississippi.

But, granting that the simple system of putting surplus labor on surplus land will minimize the evil of congestion, it may be asked: (1) How are the unemployed to be transported to the place where labor awaits them? (2) How are they to be supported after they get there? (3) Having completed their labors on the canal and taken up a small irrigation unit under it, how are they to be sustained until they get returns from their crops? (4) How is the large capital which will be required by construction companies to be raised?

In answer to these questions it may be said: (1) Colonizing experiments have shown that the burden of transportation, in case large bodies are organized to go to common

points, is lightened in several ways. Western railroads are interested in the irrigation movements, as settlement of their tributary territory is their only hope of profitable operation. Furthermore, construction companies make advances on wages, because they are obtaining not merely laborers, but settlers who are to make their investments profitable. (2) Laborers will be supported after their arrival and during the period of their work on canals by construction companies which will pay so much a month and board. (3) The problem of supporting a class which starts without original capital during the period intervening between the planting of the crops and the harvest is the most serious question in the list. But it would seem to be feasible to pay the settlers but little cash for their labor while working for their board on the canals, and to pay the balance in orders good for seed and provisions. Under this plan each settler would have the same capital. (4) Capital will be raised for these enterprises in the same manner that it is raised for others. The class of securities which can be offered, based on the water rights and ultimately on the land, will be "gilt-edged." The first capital required would probably be advanced in the West and by contractors. Ultimately it would be realized by the sale of securities. The holders of western railroad stocks and bonds should furnish a large market for these securities, since the reclamation and settlement of these lands is the only hope of making the railroad property remunerative.

If these conditions be true, Arid America can perhaps contribute to the solution of the problem as to how tenement wretches may become a community of home-builders and bread-winning citizens.

b. By improving the condition of the laborer. The principal ills from which laborers as a class suffer to-day are unemployment, insufficient remuneration for work done, and a feeling of dependence. Irrigation by promoting intensive farming lowers the margin of cultivation and thus increases the productiveness of the laborer, the source of his

real wages. The small farm unit, requiring little capital for its cultivation, affords a ready market for unemployed labor and makes that labor independent of the entrepreneur class and the pauperization plans of charity.

Fourth, irrigation confers direct benefits on the State as distinguished from the individual.

a. By widening the basis of taxation. Taxes are generally paid out of the annual national production, although they sometimes encroach on the capital plant or the accumulated wealth of society. Considering the sources of taxation as furnished by the irrigated farm, we find that the annual farm production by irrigation in Utah in 1894 was \$8,309,000, and that the value of the capital plant, based on the average value per acre and the number of acres, was \$35,587,000. The general property tax, including tax on real estate and improvements, for Utah in 1896 was \$851,607.76. Of this \$610,820, or over 70 per cent., was contributed by the 1,035,226 acres under ditch in the State, while 51,000,000 "arid acres" contributed practically nothing.

b. By making men more independent and thus fostering contentedness and patriotism. Large enclosures mean a capitalistic organization of agriculture and a system of landlords and tenants. This is exemplified by the sheep-runs of England in the fourteenth century, when labor was hired for wages by a pasturage overlord, and even more forcibly by the plantation system of the South, which required slavery for its existence. Small farms, on the contrary, mean independent tenancies, because comparatively no capital is necessary to cultivate them. This is seen in the arable fields of the old English "mark," and in the village community system of New England. And just so far as irrigation creates these independent tenancies through the small farm unit, will the instinct of protecting property rights be strengthened and patriotism be fostered. For patriotism and a contented citizenship are based, in their final analysis, on the property-right.¹

¹ First Triennial Report of State Statistician, 1895.

CHAPTER II.

METHODS OF RECLAIMING THE WHOLE BODY OF IRRIGABLE LAND.

The advantages conferred by irrigation in Utah's past history would seem to be conclusive reasons why the reclamation of its remaining irrigable lands is economically expedient. But the question arises: Can the reclamation plans of earlier years be profitably carried out, or are other plans necessary to secure a skillful supervision and equitable distribution of the water supply? A consideration of this question involves a detailed examination of three plans, viz: (1) That the lands should be reclaimed under the present land laws. (2) That the Federal Government should appropriate money and enter upon the reclamation of the arid lands it holds as an internal improvement. (3) That the lands situated in the State and now part of the public domain, should be ceded to the State, either unconditionally or with such conditions and limitations to the grant as would secure those lands to actual settlers in suitable holdings.

RECLAMATION UNDER THE PRESENT LAND LAWS.—An analysis of the provisions of the Homestead Law and Desert Land Act will suffice to show that they do not afford a satisfactory basis of reclamation.

In the first place, these laws commit the public land to the care of unrestricted private enterprise. Under the operation of the Homestead Law title can be had to land under conditions which permit of the virtual confiscation of canals built to reclaim it. The necessities of the Arid Region require for the diversion of its rivers and the rapid occupancy

of the land beneath them that canals should be built in advance of settlement.

The Homestead Law affords no security for the money required to build these canals. The lands themselves cannot be taxed to furnish this money, nor can they be made a security for its repayment. Not only this, but when a canal has been constructed parties can file on the land which it has been built to reclaim under exactly the same conditions that they can file on the lands above it. They are not required to become users of water; but, by five years' residence and the payment of \$18, can obtain title thereto and hold it for speculative purposes as long as they choose, without in any way contributing to the support of the enterprise which gives it its value. Thus the investor in canals for public lands is at the mercy of the people who may occupy these lands, and the legitimate profits on his investment are reaped by others.

The Desert Land Act is an anomaly. Under the provision of this act settlers may take up 640 acres upon the payment of \$1.25 per acre and satisfactory proof of reclamation. These are terms with which it is impossible for settlers to honestly comply. A vast proportion of the arid lands are situated in immense tracts, only reclaimable by the diversion of large streams and the construction of costly works. It is ridiculous to believe that a single settler can expend a sufficient amount to divert a large stream in order that he may prove title to 640 acres of land. And yet this is precisely what the law supposes. Upon this theory millions of acres have already been disposed of. In practice, however, a law ostensibly in the interest of the individual is used by corporations as an instrument by which they may acquire lands for purposes of private speculation. These corporations acquire the land at the cost of reclamation, plus \$1.25 per acre, plus the stipend of the men they hire to assist them, and then sell this land back to real settlers at prices ranging from \$20 to \$100 per acre. As the land and water-rights are worth this price, it is a good bargain

for the settler as well as for the company; but if the people are to acquire possession in this way, the law should at least provide a plan by which it may be honestly accomplished.

In the second place, the land laws now in operation encourage the wasteful use of water by failure to place restrictions on the construction of small canals and ditches. Under the present land system, which is the outgrowth of the experience of the humid districts and is wholly unsuited to the conditions of the Arid Region, it matters not how wasteful the methods of reclamation may be, provided only there is satisfactory proof of reclamation. No provision is to be found in either the Homestead Law or the Desert Land Act with regard to the utilization of natural drainage lands or the construction of ditches and reservoirs in such a way as to reduce evaporation and seepage to a minimum. For instance, it is generally held by irrigation engineers that the storage river near the mountains is better than storage on a desert plain, even when the cost of such mountain storage is much greater than the same capacity at a lower level; because seepage from the high level reservoirs frequently reappears at the lower levels and is not entirely lost. Yet, in spite of the temptation to individual settlers and corporations to construct their storage works at lower levels where smaller sums of money will be required, the present land laws do not attempt to enforce their construction at higher levels. So far then from advocating the reclamation of more land under these laws, the writer believes that the wasteful use of water due to the rigidity in their workings warrants their repeal.

RECLAMATION BY THE GOVERNMENT.—To secure a satisfactory reform in present methods one condition is absolutely necessary, viz., the land and water must be placed under one control. State authorities are absolutely powerless to control the diversion of water so long as the general government permits the unrestricted construction of ditches across public land. One of two things must happen—either the General Government must assume control

of the public water supplies and their division among appropriators, or the control and management of the land must be transferred to the several States. Control of the water supplies by the government would practically mean reclamation by the government. The most effective means of securing this result would be the appropriation by Congress of a sufficient sum of money to construct irrigation plants for a limited area in each State, the lands so supplied to be sold at prices covering the cost of the work to be done, and the proceeds applied continuously to extend irrigation until all lands, so far as practicable, were supplied. The arguments that present themselves in favor of reclamation by the Government are:

(1) The theory of government reclamation has proven historically a success. In Egypt 6,000,000 acres were reclaimed as a national project.¹ In India, under the full control of the British Government, 26,000,000 acres have been reclaimed and 110,000,000 people have been maintained upon the products of the irrigated soil.² The Crown is the general landowner and controls the water supply from the streams. All waste and unoccupied lands are distinctly managed by the Imperial Government. The government even controls the distribution of the water. Rentals are assessed and collected by imperial employees. It is the policy of the government to loan money for public irrigation works whenever desired, and this loaning system has become such a traditional policy that 75 per cent of the value of the land to be reclaimed may be borrowed from the imperial administration. In Spain and Italy the government also has full control, but it is stated that after payment for water has extended over a certain number of years the water becomes appurtenant to the land, the only tax thereafter being for maintenance and management. The experiments of France, Algeria, Australia, the Argentine

¹ J. Barois, *Irrigation in Egypt*, Paris, 1887. Translated by Maj. A. M. Miller, U. S. A., Washington, 1889.

² H. M. Wilson, *Irrigation in India*. Transactions, American Society Civil Engineers, xxiii, 1890.

Republic and Peru also prove the success of the experiment of government reclamation. And while there is no definite criterion by which to measure conditions in the United States, it may be asserted as a principle that our government has never made a failure of any enterprise it has undertaken within its own boundaries, either as a partner or as a controlling power.

(2) The water supply would be controlled by one sovereign power, and its equitable distribution would be subject to one sovereign law. Eighty-five per cent of all the flowing waters within the Arid Region have their sources in four States, viz., New Mexico, Colorado, Wyoming and Idaho. The Bear river, northern Utah's chief source of water supply, rises in southeastern Idaho. In both Utah and Idaho the doctrine of priority of right, in a modified form, exists as an established rule of law, and the exercise of this right frequently prevents a normal supply of water reaching Utah. Were the Government to assume control of the water supply of the different States, three or four States would no longer control rivers containing an amount of water sufficient to reclaim the irrigable lands in all the States. Difficulties arising from differences in inter-state water laws would be obviated, because national control would unify all systems.

(3) The Government could raise the funds required to construct storage reservoirs and to otherwise conserve the water supply at a less expense than could be done either by State or private enterprise. Money raised by private enterprise would cost at least 7 per cent; by the State, from 5 to 6 per cent; while the general government could obtain it at a rate not to exceed 3 per cent. This is an important consideration; because, as the cost to the farmer is governed by the interest upon the money invested, his water rate would not be more than one-half as much if the improvement was made by the general government.

(4) Government reclamation on condition that the lands be sold to the settler at cost would not only insure the set-

tlar a home at a minimum outlay, but would be self-supporting. The British Government in 1886 had spent \$70,000,000 on irrigation works in India, and the total amount of income on the \$70,000,000 was upwards of \$5,000,000, or $7\frac{3}{4}$ per cent on the cost. Reasoning by analogy, we can claim remunerative returns from irrigation as a national project in the United States.

Among the points that can be urged against government reclamation are:

(1) It savors of paternalism. Anything tending to increase the area of cultivation west of the 100th meridian, aided by the Government, would be resisted by the people of the East, who have already settled upon farms that they have earned and paid for by their own toil. Eastern farmers would never be convinced that it was right to put money in the Federal treasury to create farms in the West, and bestow the expenditure upon men who are to till those farms. To bring other farms under cultivation would be to bring competitors into the field; to enlarge the area of cereal production would be to increase the supply and reduce the price of breadstuffs, and to this the Central States would never consent. On the other hand, it may be argued that since Monroe's special message to Congress in 1824 favoring internal improvements, the Government has appropriated vast sums of money for the improvement of rivers and harbors on the ground that such improvement is promotive of the general welfare; that the judicious investment of capital for the reclamation of land, for the provision of more homesteads for the American people, for the addition of more material wealth to the country would be more beneficial than the policy of building levees for the improvement of rivers.

And again, it may be claimed that government appropriation would only amount to the government's buying water for part of its lands to make them worth from ten to fifty times what they are to-day, and paying for the water in land that it perhaps could not give away if the works were not

built; in short, that instead of being a subsidy, an appropriation would be merely a business investment by the government offering to water its worthless land and take pay in kind. Yet, inasmuch as the Western people would be most directly benefited by the reclamation and settlement of these lands, and as there are many who believe that an addition to the annual agricultural output would not find a ready market, it is questionable whether irrigation would legitimately fall within the domain of national activity.

(2) To attempt at this time to formulate a uniform system of laws for all the arid States and Territories would work a great hardship on the present irrigation interests. If, in the beginning of the settlement of the Arid Region, the General Government had exercised the same supervision over the division and use of water that it did over the settlement and acquiring of title to land, there might have been a question as to the wisdom of such a policy; but now that each State and Territory has built up its own code of laws in regard to water-rights, forming the basis and protection of property rights of enormous value, a uniform system of laws incident upon government control would involve untold confusion in irrigation interests. Conditions vary so much in different parts of the Arid Region that water laws applicable to one State would be ill-suited to another. For instance, municipal ownership of public works as embodied in the Wright Law of California represents the most economical way of handling water in California, yet it would be wholly unsuited to sparsely settled portions of Utah.

(3) As for the supervision of inter-state water sources by a single authority so as to prevent a few States from monopolizing all the water of inter-state streams, the organization of the streams in question into natural irrigation districts under local supervision would accomplish the purpose better than supervision by the General Government. Indeed, the simplest solution of the problem of inter-state waters would seem to be the formation of a district embracing all

the irrigable lands within the catchment area of the interstate stream and its tributaries, the irrigators within the district to control the distribution of the water supply, and to plan and construct their own irrigation works in such a manner as they may devise.

Local supervision of these districts would be preferable to national, because it would be a better protector of vested rights. In the Arid Region an inadequate supply establishes a limit to agriculture. Every tract of land sold results in establishing a new interest and a new right adverse to existing interests and rights. Therefore the important question arises, how far shall new interests be established, new rights accrue, and additional lands be sold in order that present interests may be protected? In each of the districts the people actually cultivating the soil ought to have the right to decide whether new tracts shall be taken up, that is, whether there is more than water enough to supply their own wants. If there is not, then the present right should be protected. The people should have the right and, by some means, have the power to decide whether it is to their interests to have new settlers come in and divide the waters with them on new lands, or to come in and divide the waters already in their possession. If a man owns a tract of land for which he has paid and for which he has entered into an obligation to pay with the expectation of redeeming that land by irrigation, his right and power to so redeem it should not be curtailed.

(4) Reclamation by the Government would create a new corps of officials who would likely be removed at every change of administration. In no department of public activity is it more necessary that competence should be the sole criterion in the selection of officers than in the department of public lands. The day of the engineer has come in irrigation problems. There must be a closer husbanding of the water supply in order to meet the needs of a denser population. There must be a protection of the sources of all streams used for irrigation by stopping the

ruthless cutting away of timber and the second growth of timber and the underbrush that holds the snow in the spring. It must be done for the safety of the stream and for the safety of the country below, which is subject to devastation by sudden floods.

Johnstown disasters may be precipitated by incompetent supervision of dam and reservoir construction, and by a failure to divert from the natural channel the water which has been allowed to flow into it from the reservoir higher up the stream. This risk can best be reduced to a minimum by a periodical inspection by a state board, in which sufficient authority should be vested to order the necessary repairs. The successful history of the earlier stages of irrigation in Utah when local water-masters were appointed, to be retained in office during good behavior, proves that a non-partisan and distinctly local board of control, composed of men who understand the topography of the country, could remedy existing evils better than officials appointed by partisan administrations, in whose eyes the reward for party service is as eminent a qualification for office as competence.

These considerations lead the writer to believe that the construction and supervision of storage reservoirs by the General Government for the purpose of reclaiming the arid lands which it holds would be impracticable.

Yet there seems to be no valid reason why national aid should not be given for the discovery of waters suitable for irrigation, for the prosecution of surveys necessary to determine the location of land susceptible of irrigation, and for the selection and segregation of reservoir sites. Large annual appropriations are made for geological and topographical surveys, yet since 1878, when Major Powell first called attention to the importance of irrigation as a source of national revenue, only \$300,000 has been appropriated for the investigation of the resources of the Arid Region. The very fact of congressional remissness in failing to render substantial aid in prospecting the irrigable lands is

a conclusive argument why some plan other than reclamation by the government should be adopted. It may be seriously doubted whether the remaining irrigable lands will ever be reclaimed if their reclamation is left to direct appropriation by the government.

STATE CESSION IN TRUST.—A plan which, hedged about by certain limitations, would seem to afford a satisfactory solution to the problem of reclamation is what may be termed "State Cession in Trust." This plan proposes that Congress should cede to each State of the Arid Region, or to each Territory on becoming a State, all the non-mineral lands within its borders now held by the General Government, such State or Territory to be charged with the reclamation of these lands and with their disposal to actual settlers. The arguments in favor of such a plan are:

(1) Precedents exist for the policy of state cession. Ex-Governor Thomas of Utah recently prepared a paper¹ showing the donations of land that had been made to the older States and Territories, since the adoption of the Constitution, for purposes of internal improvement, education and reclamation. These grants amount to 225,615,171 acres. The most noteworthy case of cession for purposes of reclamation is in connection with the disposition of the swamp lands. Commencing in 1833, the government has ceded over 40,000,000 acres of swamp lands to the States of Alabama, Arkansas, California, Florida, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio and Oregon. The reason for such action on the part of the government was expressed in the grants to be a knowledge that a considerable expense would be involved in fitting them for reclamation.

It may be argued that such is the condition of the arid lands to-day, with this difference, that the problem of reclamation is infinitely more difficult than that of draining

¹ Arthur L. Thomas, *Reclamation of Arid Lands*, Salt Lake City, 1894.

the swamp lands, and also that the swamp lands were of comparatively little value and of so slight a concern to the public that they were made liable to maladministration; whereas, in the case of the arid lands, as soon as they come under the control of the State they will at once become the most prominent question in state politics and be of so great and immediate importance to its citizens that their administration will be conducted under the surveillance of a deeply concerned people. As will be seen later, the subsequent maladministration of the swamp land grants, due to absolute instead of conditional cession as is provided for in the present plan, makes the precedent here cited a weak one; yet the fact that a precedent does exist should suffice to disarm those critics who apply the doctrine of paternalism to the cession in trust of the arid lands to the States and Territories in which they are located.

On the merits of the proposition, the doctrine of paternalism would not apply with the same force to the cession of lands in trust as it would to the unconditional appropriation of government revenues for the benefit of a particular section. For the public lands are merely held by the Government as a trustee until they can be suitably settled and occupied by *bona fide* settlers, hence their cession to the States in trust would be merely an exchange of trusteeship and not a sacrifice of any property on the part of the government. In short, direct appropriation would involve a transfer of ownership, while cession in trust would merely involve a modification of relationship. The relation of trustor and trustee between the General Government and the State has been created, with successful results, in the cases of Illinois and Iowa. These States obtained the public domain lying within their limits in order that they might regrant it to railways and thus secure transportation for their surplus products to the markets of the world. So there would appear to be not only a legal justification for such a relation between the Government and the States of the Arid Region, but strong historical precedents.

(2) The failure of the Government to render adequate assistance to the people of the various States and Territories of the Arid Region in their efforts to reclaim the remaining irrigable lands has imposed upon the local governments of the Arid Region requirements and expenses not encountered by the States of the Humid Region. The principle underlying nearly all the problems confronting Utah's irrigators is the fact that the area of land susceptible of irrigation exceeds the available water supply.

As the construction of storage reservoirs and the provision of means to secure a more economical diversion of water are enterprises too great in cost and magnitude to be undertaken by private individuals, and, as no commensurate appropriation has been made by the general government, the State itself must eventually assume the responsibility which the construction of reservoirs and other distributing works will involve.

Additional taxation to meet these expenses would be resisted by the people of Utah. By many it would be regarded as unjust to tax other industries of the State for the direct use and benefit of irrigation, in the hope that the annual income of the irrigator would so increase as to eventually distribute the burdens of taxation. The only alternative left is the transfer of the control of the non-mineral lands within Utah's borders to the State itself, the money obtained from the sale to individual settlers of the land so transferred to constitute a fund for the erection of the necessary works.

(3) Neither municipal nor state taxes can be collected upon government lands; but if these lands were ceded to the States in which they were located upon such conditions as would insure their reclamation either by sale to individuals or corporations, they would be merged into private ownerships and would be subject to taxation. So long as these lands furnish free range for corporations engaged in raising cattle, sheep and horses they will constitute a barrier to Utah's progress; because, under the present land laws,

neither the Government nor the State receives any revenue from them, and their use by stockmen constitutes a charge upon the small per cent of property already yielding a revenue.

(4) The State is better prepared to undertake the reclamation of land lying within its boundaries than the general government. Irrigation, in its final analysis, is distinctly a local problem. The people of an arid State are more likely to be thorough students of its possibilities than government officials 3000 miles away. It is a maxim of public finance that the representatives of localities best attend to their particular interests. Yet this delegation of particular functions to particular localities, characteristic of a well ordered State economy, has been wholly disregarded by the Government of the United States. This government attempts single-handed to administer a domain actually more vast in one compact form than was ever drawn together under one single civil polity. A department so widely separated from the conditions which it attempts to administer cannot be expected to be thoroughly conversant with local needs.

In order to determine the resources of an irrigation enterprise, the streams must be examined and gauged; the contour and slope of the lands themselves so thoroughly understood that there will be no part of their area in which the character and extent of the land susceptible of irrigation is not known. Differences of topography in the different parts of the Arid Region are oftentimes so important as to make it advisable to pursue different methods in increasing the volume of water, and thus the method most desirable in one State is frequently the least desirable in another. For instance, in Utah good reservoir sites can be so easily obtained that it is more profitable in the long run to construct storage reservoirs than to sink artesian wells; while in the Dakotas conditions are exactly the reverse.

Again, each State and Territory of the Arid Region has its distinctive law controlling the appropriation of water among the various claimants. Utah has developed the sys-

tem of priority of rights through a control exercised by a religious corporation. Colorado and Wyoming have enacted positive legislation in the direction of state control and supervision of water rights. California and its necessities have evolved an administrative policy based upon the principle of community ownership of natural waters. In each of the arid commonwealths the law of water rights is merely the legal recognition and establishment of local custom founded largely upon the commonwealth's necessities.

Water rights from their nature are conventions rather than laws. This being true, it would be manifestly unwise to attempt to engraft the laws of other States and Territories into Utah's code, because they are wholly unsuited to its local conditions. Diversity rather than unity is needed in the enactment of water laws so as to secure the maximum benefit to each State and territory of the Arid Region. This consideration, taken in connection with the fact that natural conditions in the different States are variable, warrants the conclusion that the ceding of the irrigable lands to the people who are to occupy them is to hand them over to the highest and most direct intelligence in their administration.

(5) State cession would vest the control of the land and water in the same authority. A major portion of the lands to be reclaimed in Utah, as in other sections of the Arid Regions, belongs to the National Government, while the ownership of the unappropriated waters necessary to irrigate these lands belongs to the State.¹ If the State could control the disposal of the irrigable lands, as well as the unappropriated waters within its borders, it could dispose of such lands to actual settlers and afford additional protection to canal owners. The canal owner would no longer feel that he was making an improvement on property over which he exercised no control; for he could purchase land

¹ Sec. 424, Compiled Laws of Utah, 1888.

from the State with water-right attached, and thus he would have an adequate security for his investment. But state control of the unappropriated water without control of the land tends not only to separate the elements constituting the basis of property in the Arid Region and to thwart all local effort to control, but encourages the creation of monopolies in both land and water.

(6) The possession of the arid land would enable the States to exercise a systematic supervision over the diversion and use of waters. State authorities are absolutely powerless to control the diversion of water so long as the General Government permits the unrestricted construction of ditches across the public lands. If the lands affected by these laws were ceded to their respective States and Territories, and the responsibility for their reclamation shifted from the general to the local government, the land so ceded would be beyond the reach of the General Government and the state government could assume an effective control over the waters within its borders. Without attempting to elaborate the merits of state supervision of water at this juncture, two benefits accruing therefrom may be mentioned in this connection: (a) The State could then exercise a reasonable discretion in the matter of granting privileges to construct canals or reservoirs, thus preventing appropriations of water in excess of the actual requirements of the land to be irrigated and protecting the rights of those who lawfully appropriate water. (b) The State could conserve the water supply by exercising supervision over the location and erection of irrigation works.

(7) By placing the disposal of the grazing land, along with the irrigable lands, in the hands of the local government, ample provision for their protection, control and transfer in suitable and contiguous tracts to actual settlers would be made. The present policy of the government is to afford no protection to the grazing lands, but to leave them open and free to every individual or corporation owning flocks and herds. This policy has resulted in a ruinous

overstocking of many ranges, and a consequent destruction of the productive power of the soil in the localities where such overstocking prevails. The importance of Utah's pastoral interests is such that provision should be made for the protection and utilization of the grazing land in connection with the contiguous irrigation areas. To the grazing lands, as distinguished from the agricultural lands, belong those vast areas of elevated table and bench land and the high, rolling divides which lie upon the summits and along the slopes of the watershed. They comprise about three-fourths of Utah's domain. They can never be made the self-supporting habitation of man, because they are too elevated and too vast in extent to be irrigated; but they furnish a valuable complement to the lands reclaimed, the first supplying the summer's and the latter the winter's food supply.

Adequate provision for securing possession or management of these lands for the sole purpose for which they are adapted has never been attempted by Congress, and the question is of such importance that a great impetus would be given irrigation in Utah if the State was in a position to encourage settlement by attaching to the land capable of being reclaimed a larger contiguous tract of grazing land. It would make more valuable the irrigable acres and supply the settler with an important source of income by adding the business of stock-raising to that of farming. Attach the grazing land to the irrigable land and the water supply, and while the agricultural interests are rapidly increasing in value, the stock-raising industry of the plains, although no longer carried on by large aggregations of capital as in the past, will grow in importance and add increased wealth to the nation.

On the other hand, a failure to cede the grazing lands along with the tracts capable of being reclaimed would work a great injury to the State, and at the same time be a source of continual annoyance and expense to the General Government with no corresponding gain. A failure to cede these grazing lands would be injurious to the State, because the

strife between the settlers for the possession of these large tracts of "no-man's land" would be interminable, and the only authority having a direct interest in the question could exercise no control. A failure to cede would mean a loss to the Government, because now the grazing lands belonging to the Government cannot be sold, while under state ownership they could be allotted or leased, and the revenue accruing from their rental would be sufficient for the administration and protection of both pastures and forests.

(8) Forest lands should be ceded to the State because of their intimate and inseparable relation to irrigation. This relation is easily appreciated when it is known that forests are useful not only in inducing an increased precipitation, but in securing a proper distribution of water throughout the year. Careful observations by the Utah Forestry Association show that the air over a forest is a little cooler and contains more vapor of water than the air over a plain. Hence, the conditions are more favorable for the precipitation of rain over a forest when a current of moist air passes over it than when the same passes over a desert. "It has been even suggested by some scientists of reputation," says Professor Whiting of the University of Utah, "that trees induce an electrical condition favorable to rainfall."

But it is in securing the proper distribution of water throughout the year that forests are most useful. Natural sites for reservoirs are found most abundantly in the gorges and canyons of the mountain regions, and therefore in the timbered and partially timbered tracts. Were these tracts denuded of trees, the snows of winter would be blown into the canyons, and from these into agricultural valleys at a time of the year when water is little needed, and in many cases when it would be an absolute detriment.

Yet, notwithstanding the importance of these forests as conservators of the water of irrigation streams, the Government has taken no steps to prevent the recurrent forest fires and cuttings which cause an annual loss estimated on the

basis of stumpage value alone of nearly \$100,000,000. This matter of forest protection should be of special interest to the people of Utah, because in the Uintah Reservation, which it is hoped will eventually be thrown open for settlement, four of the great irrigating streams of the State rise. These streams are the Provo river, Weber river, and several forks of the Duchesne and Bear rivers respectively. Extensive forests now surround the headwaters of these streams, but unless some measures be formulated for their reservation or protection they will soon be sacrificed for the petty gain to be realized from their cutting.

Unsuccessful attempts on the part of the Government to protect its timber lands prove that protection will not be secured until the lands are ceded to their respective States and Territories, to be placed under the supervision of local agencies. More minute supervision is required than the General Government, regulating its affairs from a distance, can bestow. A plan has been proposed by Professor Sargent of Harvard University which would minimize the loss incurred by forest depredations. Professor Sargent proposes the education of skilled foresters at West Point, the policing of the forest reservations by local guard and the administration of the system under the War Department. This is suggested as an expedient to be resorted to in case state control of the forests is not secured.

There are three objections to be urged against the policy of State cession:

(1) State cession has frequently proved a failure. Especially may the unsatisfactory experience following the granting of swamp lands be suggested as a potent objection to a repetition of the policy of cession. The experience mentioned should not be overlooked, nor should it be accorded an importance in its application to the pending question to which it is not entitled. It is true that not a single State has made a success in reclaiming the swamp lands ceded to it; that these lands have remained unproductive property so long that in many cases land departments have been

created to effect their sale at any price. Yet there are many differences to be noted between the swamp and arid land grants, and these differences are so vital that an analogy between the two will prove to be faulty.

In the first place, it must be borne in mind that the total area of swamp land granted was an insignificant fraction of the surface of the States in which the land was located. The remainder of the surface of those States was valuable productive soil. Hence the disposition made of the swamp lands was of slight concern to the State, and therefore the attention given the subject was mainly given by claim agents whose success in driving bargains was largely attributable to the fact that the quantity of land was comparatively small and the public interest smaller still. The arid lands, on the contrary, constitute the largest portion of the arable surface of the States and Territories in which they are located, hence the future prosperity of every desert-land State and Territory depends on the wisdom and practical character of the legislation enacted to facilitate and encourage the reclamation of these lands. Every man in the country who desires or may desire to secure a home on the public domain is interested. So while the swamp-land States may have been indifferent in dealing with the grant which was but an incidental matter, the desert-land States and territories could not afford to deal thus with a question of vital importance. Indifference would court adversity, and recklessness would bring ruin.

Then again, the cession of the swamp lands was practically unconditional, no other provision being attached than that they should be used to aid "in constructing the necessary levies and drains to reclaim the swamp and overflowed lands which may be, or are found to be, unfit for cultivation."¹ Naturally such an unrestricted grant was open to abuses at the hands of aliens and foreign corporations. But the plan that has been suggested for the cession of the arid land to the States and territories in which they are

¹ U. S. Rev. Statutes, Sec. 2479.

situated imposes upon the trustees the obligation to dispose of them to actual settlers; so, whether the lands thus ceded should be reclaimed as a public enterprise under the management either of the States themselves or of municipal corporations, or as a private enterprise operated by private companies, it does not appear that the grant could be abused.

(2) The control and distribution of the land so ceded by the legislatures of the respective States and Territories would likely put a premium on land frauds. Without attacking the honesty and intelligence of western legislatures, it may be claimed that if any of the land should fall into the hands of States whose treasuries were low and whose limited populations were already taxed to their fullest extent, there would be a strong incentive to turn the lands over to large corporations. Granting that such a contingency might arise, it may be inquired: Would corporate control monopolize more of the individual settler's rights than the present grotesque land system?

The thesis will be subsequently advanced that speculative enterprise has a legitimate and useful function to perform. This would be especially true if such enterprises could be brought within the jurisdiction of the State, which, it is to be presumed, would be more jealous and watchful of its interests than the land department at Washington hundreds of miles away. If corporate control is an evil *per se*, then State cession would be beneficial, because it would put a stop to the selfish land-grabbing carried on under the present land laws; on the other hand, if it be granted that corporate control has a useful function to perform, then state cession would be equally as beneficial, because legitimate corporations could act as agents of the State and would no longer be regarded by the individual settler as monopolists whose profits were the reward of waiting rather than of working.

(3) 2,304,000 acres of irrigable land, constituting 63 per cent of the total irrigable acreage of Utah, have already been ceded to the State under the Carey and Enabling Acts.

Why, it may be asked, should the Government cede the total amount of non-mineral land in the State before the State's ability to reclaim and utilize it to the best advantage has been thoroughly tested? Because, by placing a limit to the acreage ceded, the government would place restrictions upon whatever administrative system the state legislature might choose to adopt. To secure uniformity in administration would be the only reason why the State would make the land ceded by the Government a part of its industrial domain. This motive, which would exist provided the State owned *all* the non-mineral lands within its boundaries, does not exist to-day because a part of the State's domain remains in the hands of the government.

The policy of the State regranting the lands to public corporations organized under the district system is weakened by the restriction upon the original grant from the government to the State, because irrigation districts are bounded largely by the topography of the country, and thus, in their formation, state lands might overlap government lands. The board of trustees of the district, being the creature of the state legislature, would have no jurisdiction over government lands, and thus the effectiveness of the district system in many instances would be destroyed.

Finally, should the State deem it wise to place the lands already ceded in the hands of capitalistic enterprises for purposes of reclamation, the disadvantage incident upon the restriction of cession is apparent. The field of employment for capital being more limited, and the risks greater than would be the case if cession was complete, larger interest rates would be charged by the promoters of capitalistic organization.

These considerations lead the writer to believe that "State Cession in Trust" is the only available policy by which the whole body of irrigable lands in Utah may be reclaimed. And in accordance with this policy he recommends that the Uintah Indian Reservation be immediately thrown open to public settlement, and that the lands now held in fee by the Government should be ceded to the State.

CHAPTER III.

ADMINISTRATION OF THE IRRIGABLE LAND ALREADY CEDED TO THE STATE.

From every point of approach the cession of the whole body of non-mineral lands to the State would seem to be economically expedient and justifiable. However, a problem vastly more momentous than the one of extending the policy of state cession confronts the people of Utah.

This problem consists in the adoption of a well-defined administrative system, under which the lands already ceded to the State may be reclaimed. Utah's Constitutional Convention and first Legislature failed to make any provision whatever for the administration of the grants under the Carey and Enabling Acts, and the second Legislature, which adjourned March, 1897, accepted only the Carey grant and failed to devise a policy by which the whole body of irrigable land held by the State might be reclaimed.

As outlined in the introduction, three methods of administration merit a detailed examination: (1) Reclamation by the State itself. (2) Reclamation by public corporations with water districts organized under the laws of the State. (3) Reclamation by private enterprise, operating under grants from the State with proper restrictions imposed upon the grants.

RECLAMATION BY THE STATE ITSELF.—The industry of irrigation is one peculiarly combining the advantages and disadvantages of the industrial domain. Supplying through taxation the bulk of the revenues for the support of the larger public powers of the State, it may be said to be analogous to state factories which furnish directly the equipment of fleets and armies. As state establishments for the

production of munitions of war are defended on the ground that superiority in quality is more important than reduction in cost of management, so irrigation as a state industry may be defended on the ground that the construction of durable works for the delivery and distribution of water is more important than reduction of cost to the consumer.

Again, the history of irrigation in Utah warrants the statement that it is an industry in which there is a tendency to the establishment of a monopoly, and in which the establishment of a monopoly by the State would likely prove economically advantageous. Irrigation possesses all the qualifications characteristic of monopolistic industries,¹ because: (1) The products of irrigation consist of necessities of life. (2) Irrigation is connected with special localities and situation is an element in its advantages. (3) Irrigation is usually subject to the law of increasing returns, and thus concentration and unity in management tend to cheapen the product. (4) Irrigation is associated with local control rather than control by the general government. (5) Competition is not steadily operative. The ablest financiers and economists agree that the water supply for domestic uses should be made a part of the industrial domain, because of the danger of monopoly on the part of its holders. How much more, it may be argued, should irrigation, in which the prime factors of land and water are both subject to monopoly, be managed by the State itself?

While recognizing fully the fact that there are qualities inherent in irrigation favorable to state management, the writer sees objections which do not bode well for the financial success of such a policy. These objections are:

(1) The construction of the needed public works for the reclamation of land by the State would involve either an increase in taxation or the contraction of interest-bearing bonds. The people of Utah are not in a humor to bear an increase in public burdens. The transition from a Terri-

¹ C. F. Bastable, *Public Finance*, 68.

torial form of government to that of a State involved an increase of one-third in the rate of the general property tax, most of which is levied on the owners of irrigated land.¹ Practically all the municipalities of Utah have exceeded the 6 per cent bonding limit allowed by Congress, and in addition have incurred a large floating indebtedness. This unhealthy financial condition is not calculated to inspire confidence in any state enterprise, however flattering the opportunities may be for gain. For when investment means increased taxation or an addition to a heavy debt charge, the expectation of future profit is not a sufficient incentive to induce men to discount the future.

(2) If irrigation becomes a part of the industrial domain, there would be a sacrifice of the revenue accruing from that portion of the general property tax levied on the irrigable lands placed under state control. On the other hand, assuming that the lands to be reclaimed were left open to private enterprise, it would be possible not only to collect a general property tax from them, but also to levy a special charge on their gains. Even if the State, reserving ultimate ownership in itself, should provide that private corporations act as construction companies, the gains of these corporations would constitute a legitimate source of taxation. In short, by undertaking the management of the irrigable lands the State would not only forfeit the right to levy a general property tax on them, but would deprive itself of all gains accruing through the channels of private enterprise.

(3) Such a policy would involve the necessity of increasing the number of state officials, and would place additional burdens upon the present state officials, whose tasks are already sufficiently varied and comprehensive. If irrigation were to be made a paying investment by the State, the State would need to exercise the same care as an individual in regard to the cultivation of the land and the economical

¹ The rate of Utah's general property tax under the state regime is eight mills; under the territorial regime it was six mills.

distribution of the water. Granting that one state employee could successfully irrigate fifty acres, the 3,654,000 irrigable acres in Utah would require 73,080 irrigators to profitably reclaim them. Twenty-five dollars per month is the minimum amount for which the State could secure the services of a competent irrigator. Calculating the total wage fund of the 73,080 employees on the basis of a \$25 per month wage, we have \$1,827,000 added to the annual state expenditures in payment for labor alone. The wages of superintendents, paid to the entrepreneurs of the state irrigation industry, are also to be reckoned in determining the cost of extending the administrative arm. Economy in administration would likely be attempted by shifting many of the burdens of management on regular state officials, whose salaries are fixed by the constitution of the State and cannot be increased. The duties imposed by law upon Utah's officials are already ridiculously varied and comprehensive, and there can be no doubt that the administration of both state affairs and the irrigation domain would suffer, if the burden were made more onerous. An extension of state administration to irrigation enterprise would mean not only a largely increased cost in state expenditures, but an impairment of the efficiency of its officials.

(4) Irrigation as a state enterprise would encourage consumers to demand lower prices for the irrigator's products, and thus destroy legitimate competition on the part of private producers. State enterprises are regarded as financial leeches by the taxpayers, who seek relief from the increased taxation incident upon the existence of these industries. There is a natural prejudice against a public corporation of any kind realizing more than a small margin above the amount required to pay interest upon the capital invested. The practical application of this principle is seen in the present state tax on the profits of irrigation corporations in Utah. Railway experiences, both in this country, where they are placed in the hands of government receivers, and abroad, where they are placed directly under state control,

bear out the statement that demand for lower rates is a concomitant of state administration.

To sum up, it seems to the writer that the increased taxation for construction of works, the sacrifice of revenues accruing from the ownership of private property, the introduction of further complexity in administration, and finally a disposition on the part of the taxpayers to demand lower prices for the products of state industry are difficulties calculated to prevent the successful incorporation of irrigation into the state domain.

RECLAMATION BY PUBLIC CORPORATIONS WITH WATER DISTRICTS ORGANIZED UNDER THE LAWS OF THE STATE.—Reclamation by public corporations with water districts organized under the laws of the State would appeal very strongly to the older settlers of Utah as furnishing the correct solution of the problem of irrigation administration. For not only is this policy fortified by church tradition, but the recent decision of the United States Supreme Court in regard to the constitutionality of the Wright District Law of California is calculated to recommend it more strongly than ever to public favor.

Before drawing any conclusions as to the relative advantages and disadvantages of the district system, it would be wise to briefly restate the plan of procedure as outlined by the Utah District law of 1865. Districts are formed by a petition of the landholders of any "county or part thereof" to the county court. By-laws for the internal government of the district are framed, taxes for the construction of the canals are voted, and the officers of the district are elected by a two-thirds vote of the holders of the land to be benefited. The money for the construction of the canal is raised by levying an acreage tax on the land within the district. The estimation of the cost of the necessary work and the superintendence of the work is vested in a board of trustees, possessing the right of eminent domain and other privileges of a public corporation. This board is required to file a

bond fixed by the county court, and its term of office is limited to two years. Only one-half of the acreage tax voted is collectable at one time, the remainder as the work progresses. The tax is held to be a lien on all water rights until paid, but is not a lien on the land. The unit of taxation is the acre. In general, it may be said that the irrigation district under the Utah statute of 1884 is a public corporation having the same powers to construct irrigation works and to furnish water to all lands within it, that are possessed by a city to construct water-works and to furnish water to its inhabitants for domestic purposes.

Having clearly in mind the conception of an irrigation district, we are prepared to consider the advisability of the State extending the operation of the district law of 1884 to the irrigable lands in Utah still unreclaimed. In its final analysis the advantages of such a course would be:

(1) An organization would be created through which the owners of a given area of land might act in concert and construct irrigation works, the cost of which would be too heavy for individual irrigators to bear. The necessity for storage reservoirs and cheaper methods for the diversion and application of water plainly places future irrigation development beyond the reach of the individual and the crude co-operative society, in which labor is the sole basis of stock. Yet the district organization effects a compromise between the traditional labor-co-operative policy of the church and the private capitalistic enterprise; because, through the exercise of powers of local self-government in which the collective will of the people composing the district is represented, the district becomes a mutual corporation, raising stock and distributing profits on the co-operative plan. The board of trustees of the district is a corporation in the eyes of the law, yet it is a corporation in which the consumers are the shareholders and in which a monopoly in land and water would be financially suicidal. Co-operation in the establishment of a construction fund, co-operation in the election of officers to administer that fund, and co-

operation in sharing the benefits received, are the essential provisions in the charter of a district organization, differing only from the cruder co-operative enterprises in that capital, and not labor, is the basis of stock, and the district, not the municipality, is the irrigation unit. Effective organization is thus established on popular and yet on business principles. The directness and certainty of individual effort are not crushed by organization, yet by virtue of being a public corporation the district possesses powers which individuals as such cannot exercise.

(2) The district system would promote association in the control of water, and thus virtually guarantee that water would be supplied to the consumers at the bare cost of diverting it from its natural channels and applying it to the lands. Associative control in irrigation has a logical justification. Water in due proportions at stated intervals of time is an absolute necessity to the success of each cultivator. By nature water is a thing not permanently divisible nor once-for-all distributable. The water must be acquired in bulk and subdivided in distribution, and this operation is necessarily continuous throughout each recurring season of utilization. Like the air, that which is not momentarily in use is part of a great undelivered, unappropriated common stock. Some small but exceedingly small part of it, as a whole, may be trapped in a reservoir or herded between the banks of a canal in process of delivery. But this is only the segregated part of a great common property of all men, in private possession of the reservoir or canal owners. No system of law nor custom of country can change its character and function in the economy of nature, as affecting human existence, nor alter the disposition of mankind in contemplating its utilizations necessary for that existence.

Of all the uses to which water is put, irrigation is the one in which the interests of individual users are the most interdependent and inseparable. There is a community of interest in every cubic foot that comes into a canal heading and all that escapes at the drainage outlets of the system. The

sum of the indirect influences of individual irrigation practice on community welfare, taken with the aggregate of the direct effect of each irrigator's practice on the interests of others, is so potent as to make this industry one of the strongest in its tendency towards socialism amongst enlightened and progressive peoples. Why? Because progressive human nature will not long endure autocratic rule, no matter how justly exercised, in the distribution of that which is an actual necessity, and is at the same time, by a law of nature, already a common property of those being served. The logical outcome of this socialistic feeling as regards the control of water would seem to be local community organization over every area whose interests admit of unification.

(3) The district system would insure the vesting of the ownership of land and water in the same hands perpetually. Thus the water right would be held by a tenure no less stable or sacred than the tenure of the land itself. We have seen that Brigham Young proclaimed the common ownership of land and water as one of the cardinal principles of his industrial system, and that the church authorities have constantly forbidden the segregation of these two elements, as tending to promote speculation. However, since the rise of capitalistic organizations many antagonisms between the supplier and applier of water have sprung up. This is the greatest evil of corporate management. In ways that are difficult to appreciate except through experience, any one or a set of irrigators may be damaged by tricky management. Incompetency or neglect on the part of the management might ruin a community, and still there would be no practical redress. The case is different in essential particulars from that of a water or gas supply in a city. In the latter case the commodity is constantly on tap on the consumer's premises. He takes what he gets and pays for what he uses. This is rarely ever the case in the distribution of water for purposes of irrigation. The irrigator is likely to receive water only when willed by the canal man-

agement, under some system more or less liberal than itself, and subject to liberal or illiberal, efficient or inefficient administration.

Fortunately, Utah's capitalistic organizations have been promoted and managed by home capitalists, interested in the future development of the State. This fact, taken in connection with the competition prevailing among them, explains why Utah corporations have made it possible to obtain water just as reasonably by rental as by individual ownership under the priority of rights system. However, it follows from the very nature of divided control of land and water that hardships will sometimes be inflicted upon the water-users by the supplying company; yet consumers frequently take advantage of a preconceived prejudice to place all responsibility for the failure of crops, no matter how diligent, fair and accommodating the company and how overbearing the user. All this goes to show that irrigation enterprises should be so organized as to result in the ownership and control of canals by those owning land to be served under them.

(4) The district system would suppress all water-right litigation. This would follow as a corollary from the associated control of water and the vesting of the ownership of land and water in the same hands. For, when water becomes common property, there is no longer a necessity for a legal definition and maintenance of rights. Again, when there is a common ownership of land and water there is no cause for complaint on the part of those consumers who depend on the use of water furnished for rental by some one else.

(5) The district system would not only require those to pay who were to be benefited, but by levying a tax on each acre within the district, would make it desirable for landholders to increase the acreage under cultivation. The Utah District Law was so carefully framed to guard against any evasion of burden by those benefited that a provision was inserted declaring that "all unreclaimed lands bene-

fited by the district ditches should be appraised and sold by the board of trustees, the funds derived from their sale to be devoted to further reclamation." As regards the enforcement of payment by those who receive benefits, the district system is an improvement on the common law, of which the system of priority of rights is a type. The common law system gives to every owner of land on a stream's bank and to every prior appropriator of the waters of such streams certain usufructuary rights in the stream. Whatever be the benefits accruing from the exercise of these rights, the proprietor is not amenable to taxation.

The district system, on the contrary, allows special privileges to none and holds all the landowners resident in the district subject to taxation for the benefits conferred. The waters belong in common to all the people; no individual or body of individuals has the right to their exclusive use, nor is any one exempt from the burden of maintaining an adequate water supply. Taxation would raise the irrigable margin, because landholders would soon realize that its incidence was heavier on the lands lying waste than those under irrigation. In the former case, an acreage tax would be a charge upon unproductive capital; in the latter, a normal charge upon revenues. This being true, the landholder would soon learn to regard the existence of an arid acre as an additional tax upon the products of an irrigated area, and as a matter of self-preservation would extend irrigation as far as natural conditions permitted.

While Utah was the first American commonwealth to adopt the district system, it is by no means a novel institution. On the contrary, however, the association of irrigators for local control of irrigation has been prevalent in the oldest civil law countries, notably Rome, France, Spain and Italy.¹ The civil law principles of common ownership of waters by the people and local association to control

¹ William Hammond Hall, *Irrigation Development*, Sacramento, 1886.

their use came from the Roman communal idea of settlement and local management of industrial affairs in the interest of the community. The Roman communal system of town organization embodied the germs of the modern district or association, in that it provided for the local administration of community property, or property held in common for all the people of the settlement. Such were the waters of streams, irrigation ditches and other works. All of southern Europe, including Spain and southern France, as well as Italy, received this system under Roman rule. But the feudal system succeeding it was antagonistic to this communal form of organization and property holding, and later, spreading throughout those countries, nearly swept away the community properties of the district government. In Spain, however, notwithstanding the supremacy of the Goths and the subsequent long occupation of the country by the Moors, the communal right, especially as applied to irrigation works and waters, survived. Following Spanish precedent and example, there came the more modern forms of community organization as applied to irrigation districts in other countries.

In the three principal civil law countries, viz., Spain, France and Italy, the association of irrigators for local control is made obligatory, no matter how the works are carried out and owned—whether by the district itself, by a contracting party, or by an individual. The idea is that the water belongs to the people, however it may be delivered to them, and they must organize to receive and protect their interests in it. The basis of control rests on the voting of lands, and is arranged in a way, so far as possible, to favor the small holder. Before any district is authorized to exercise the full right of eminent domain, or to contract a fixed debt, its limits, works, projects and water rights are subjected to a governmental examination and must receive official sanction. In every case the government reserves the power and authority to compel all such districts to pay their debts and meet their obligations;

equally protects the interests of the districts in arranging the terms of concession to companies which may undertake to deliver water for their irrigation; and provides that works and rights are, at the expiration of fixed periods, to become the property of the district served in each case. The policy of concessions to private companies, with ultimate reservation of property in the State, has also been adopted by France in connection with the construction and administration of railways. Thus we find that in European countries where the district system has been tried, most satisfactory results have been reached; so there are apparently weighty historical precedents in addition to the economic motives mentioned which would justify its extension in American commonwealths.

Yet there are certain salient objections to be urged against the district system calculated to render its further extension in Utah theoretically inadvisable and practically impossible. These objections are:

(1) The district system is a civil law institution, while Utah's system of priority of rights is an outgrowth of the common law; hence its extension would involve a confiscation of the rights established by private individuals under the priority of rights system. To adequately understand the conflicting doctrines of the civil and common law system as regards water rights, it is important that the fundamental principles of the two systems should be stated. Under the civil law water is the common property of all the people.¹ Except in that measure actually necessary for individual use, it cannot be made the personal property of any man. A stream's channel may be in private ownership, and so its banks, but its water is owned by the people at large. A stream may be public as to banks, bed and surface, but the water of this, too, is in distinct ownership, individually, in the people of the country. They each have

¹ Justinian's Code, Lib. 6, Tit. 1, Sec. 1. Water is referred to as "res omnium communis."

a proprietary interest in it. It is not a public thing—belonging to nobody or to the great public as represented by the government, but a thing owned by the people and in which every person of the country is part owner. Thus owned, it is the ward of the government in the common interest. The government looks after it, not as public property, but as the people's property. For the benefit of all it is protected from individual, private or corporate appropriations. Rights to its use are not acquired by the mere taking. They must be based on administrative permit, and are subject to administrative regulation. Such regulation does not mean curtailment or forfeiture, except as to waste and in the case of misapplication. It simply forces the claimant to comply with the terms of this concession, and to have regard for the rights of others, without forcing others to appeal to courts. The idea of association in the development of irrigation naturally follows upon that of the common ownership of waters.

Just as administrative control of streams and diversion therefrom has been erected as the framework of water-rights systems in civil law countries, so has the local association of irrigators for the control and development of irrigation within unified areas of the common ownership of waters been made the foundation. The three ideas of common ownership, state control and local association are logically bound together. The waters belong, in common, to all the people. As a common property, in which all have an interest, they must be protected from unlicensed or unregulated taking by any. The government is the natural guardian of the people's stock of common property. As a common property, the local use of waters should be in the hands of those of their owners who can to advantage be associated together at any locality for such use. If there ever was a reason for making waters a common property of the people, there is equally a reason for making their use a communal use and their control a communal control in such use.

Very different are the principles of the common law.¹ Under the common law water is regarded as a part of the stream, lake or pond in which it rests. Some waters are private property and others are public. Thus, with certain limitations as to use in the interest of the public and other owners, water in some streams, lakes or ponds is in private, and in others in public ownership. To be in private ownership subjects it to private use, regardless of the people at large, and subject only to check by the action of courts in protecting the usufructuary rights in it, and the property rights of others to it, or to the stream, lake or pond of which it is part. To be in public ownership subjects it to appropriation for private use, where such use does not interfere with public interests. The water is regarded as that part of public property which may be converted into private possession without public permission. If a stream, as such, is not injured to the public detriment by the diversion of its waters, the public is not supposed to be injured by such diversion. The people—except as a body politic, the public—have no property right or other interest in it. They are not supposed to be abridged in their actual property rights by the diversion of the water from streams. Every owner of lands on a stream's bank has, under the common law, certain rights in the stream and its waters. In short, the riparian owner and prior appropriator are the possessors of vested rights as sacred as private property and tolerant of no governmental interference.

The introduction of the district system by the law of 1865 has already involved the confiscation of prior rights amounting approximately to \$10,000, and thus seriously impaired the security of private property. This has been the natural result of the introduction of a civil law institution into a State where common law institutions have

¹For statement of application of the principles of the common law to irrigation, cf. Gould on Waters, Secs. 4, 5, 10; article by William Hammond Hall on Irrigation Principles in "Irrigation Age," Dec. 1894.

heretofore been recognized and enforced. The widening of the area to which the district system would be applicable would involve a confiscation of vested rights in the region where the remaining irrigable lands lie. Private claims have already been staked off on tracts now lying dormant in the hands of the State, and the inclusion of these claims within districts where the right to use is a right held in common by the district landholders, would scale down the value of the individual appropriator's right to the use of the amount of water he had appropriated.

The exercise of the right of eminent domain is a fundamental criticism of the district system, so far as it works a hardship on the earlier individual irrigators, and creates a fear lest the security of private property be impaired. The exercise of the right of eminent domain is only justifiable when private property is taken for a public purpose, and it may be seriously doubted whether the distribution of the water acquired by the district for irrigation purposes to the landholders within the district is a public purpose. To say the least, the outcome of the introduction of the civil law into a common law State would be a chaos as regards jurisdictions, a chaos as regards rights, and a worse chaos than all as regards areas.

(2) The feasibility of district organization is dependent on two natural conditions, which are not found in the southern part of Utah, where the lands to be reclaimed are located. These conditions are: (a) Population. (b) The lands to be included must all be susceptible of irrigation by water from a common source of supply.

The district system follows settlement, but does not precede it. This is obvious when it is considered that an irrigation district is analogous to a local unit of public finance in its dependence on an organization and taxing power. That the section of the State in which the lands to be reclaimed are located does not meet this fundamental condition of population may be seen from the fact that in 1895 there were only 4467 inhabitants in the counties of

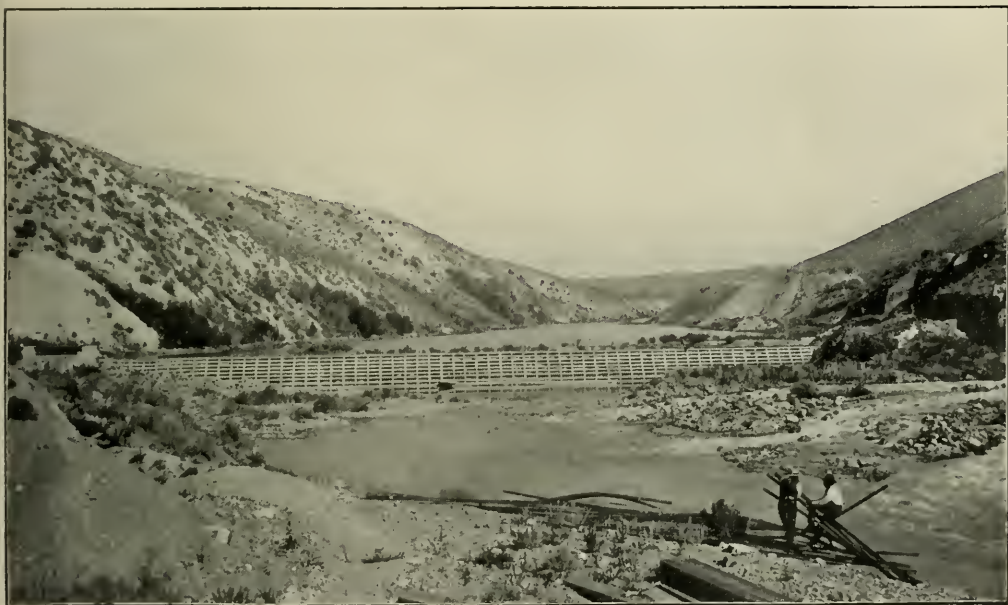
Uintah and San Juan, containing a major portion of the lands in question. The existence of creeks and small streams and the absence of large rivers in the southern part of Utah defeats the second requisite for district organization, viz., a common water supply for the lands to be districted.¹

These considerations force the conclusion that the reclamation of Utah's irrigable lands through the district system would be impracticable.

RECLAMATION BY PRIVATE ENTERPRISE, OPERATING UNDER GRANTS FROM THE STATE, WITH PROPER RESTRICTIONS IMPOSED UPON THE GRANTS.—The only alternative that remains is the one most opposed to church traditions and to the historic policy of Utah for nearly half a century. The plan to be suggested is designed to protect the settler against the evils of autocratic control, while insuring the State the largest measure of irrigation development. The theory underlying the plan is that *land should be reclaimed by private enterprise, operated under grants from the State, with proper restrictions imposed upon the grants.*

Briefly stated, the specific plan proposed is as follows: That the State should make contracts with reliable private corporations, acting as construction companies, for the reclamation and settlement, within a given period, of the lands to be reclaimed in the State. The sum charged the State by the construction company should be specified in the contract. The power of fixing the price per acre for which land and water must be sold to settlers should be vested in a State Board of Control, composed of the state engineer, of a given number of irrigators from different sections of the State, and a secretary well versed in irrigation law.

¹ A small portion of the southern part of the State lies on the western side of the Wasatch mountains, and belongs to the drainage of the Colorado river and its tributaries. This is a notable exception to the configuration of that part of the State—generally cut up as it is by small creeks and rivulets.



DAM AND HEADGATE OF AN IRRIGATION CANAL.

This board of control should have charge of all the waters of the State, with authority to inspect proposed irrigation works and to supervise them while under construction. When the sum specified by the contract has been realized by the investors in the irrigation enterprise from the sale of lands to settlers, the proceeds from the sale of the remaining lands, if any, should revert to the State. In all contracts the ownership of water should be made from the ownership of the land.

In view of the deep-rooted prejudice against corporations in Utah, it would be well to explain the functions of speculative enterprise and, more particularly, to note the conditions under which speculative enterprise is permissible. In advance of irrigation there can be little or no value in desert lands. In advance of broad and expensive investigation there can be no determination as to just where conditions are favorable for great enterprise—what area and water supply can be brought together within economic limits. Individual settlers can neither make these investigations for themselves nor take advantage of the results after they are made by the government.

Without a settled population, without established land value, without a clean-cut enterprise to work to—without the advantages to be commanded only by capital and business organization—there can be no basis of credit. And hence legitimate enterprise for irrigation development of great desert areas, on the basis of district organization and credit alone, is impracticable. Moreover, the conditions which govern this result are present in modified form and lesser degree, only, in a very large proportion of the cases which Utah presents for irrigation enterprise, even where the lands are not strictly desert in character. Thus the point at which it might be said there is sufficient population and enough established value to serve as a basis for legitimate district effort is not found at the limit of purely desert conditions. There may be a well-established and sparse settlement of an area, and some value to the lands for wheat

growing or grazing purposes, and still neither a population nor a land value sufficient to form a basis for the scheme necessary for the irrigation.

In such cases, as well as those of wholly unoccupied desert lands, in order to get the people, as well as such money as can be hired for interest only on the basis of established values, a large proportionate amount of capital must first be invested, to create the margin on which mere hired or employed capital may be had. This means, unavoidably, the precedence of a speculation for profit as distinct from mere investment for interest. In the one case the capital manages the initial enterprise to make profit out of the result of development; in the other case money is employed on bonds as a security, but is managed by the community. The broad fact is that the conditions under which pioneer irrigation has to be developed are generally such as do not attract mere investment capital. The inference is plain.

When it is desirable for all irrigation enterprises to be so organized that the control of works and water supply will ultimately come to the irrigators, it is generally necessary that capital be invested in the development on a speculative basis, primarily, up to that point where the lands are settled and values established. In other words, the element of speculation generally cannot be ignored in irrigation development, unless the government, federal or state, advance its credit and its paternal management to bring the lands under irrigation command in advance of settlement. This we have seen to be impracticable.

Enterprise—speculative enterprise—must be connected with the great majority of irrigation schemes in order that they succeed. The construction of great works for the conservation and delivery of waters to make fruitful vast areas of land on which people cannot live without irrigation is surely a legitimate and worthy field for the employment of capital. If money and business organization cannot find profit and welcome in such employment, to what class of enterprises may it with confidence turn?

Given: Conditions under which the individual cannot possibly construct the means of making his living out of lands, and an aggregation of men cannot exist and carry out works without considerable money on which to live and provide materials for works which, if constructed, would not profit them until the lapse of time and the incoming of many more people; but in which, after such time, the initial profit in enhanced values would be great, if business organization has been good. Surely these are conditions under which speculative capital and organization should be admitted, welcomed and protected in legitimate gain. And just such conditions are prevalent in the southern part of Utah, where the major portions of the land to be irrigated are located. The water supply is such that it could only be utilized through the construction of storage reservoirs, too expensive for the individual settler; and then again, the sparsity of population and the peculiar system of water rights in vogue in Utah would not permit the successful formation of irrigation districts.

Granting, then, that Utah furnishes a field for legitimate speculative enterprise, the merits of the specific plan proposed will be considered in detail.

(1) Both the investor and the settler would be surrounded with the most ample safeguards in the all-important matter of water supply. The plan provides for examinations and reports by a board of control, which will demonstrate whether the water supply is sufficient, and the canals large enough and of the proper character. This goes to the foundation of success in investment and settlement alike.

(2) Capital would be furnished a security upon the land as well as upon the water supply. While the period for the reclamation of the land is limited by the terms of the grant, the company is insured a specific sum, to be obtained through the sale of the land to settlers. If industrial conditions should be such that a sale could not be readily effected by the company, the company could, in the interval between the concession and the sale, operate the work as

a part of the capital of a private enterprise; because the State would be held responsible for the sum specified in the contract. In the meantime the ownership of the land would insure the company against loss.

(3) The intervention of the State, through a board of control, as a mediating and controlling third party to the agreement, would obviate the dangers of autocracy. The board of control, by naming a specified sum to be paid for the reclamation of defined areas of land to be realized at specified rates per acre from settlers, and by the enforcement of the provision making ownership of land and water inseparable, would make the corporations entering the field mere construction companies. Their profits would increase with the speedy completion of the irrigation works, and with the colonization of the tracts reclaimed by a good class of citizens. The company would virtually become a contractor to build, maintain and operate certain works for a stipulated period of time in consideration of certain water rates being paid by the settler.

(4) The result ostensibly aimed at by the district system of vesting the ownership of land and water in the same hands perpetually would be accomplished by the company's sale to the individual settler of a certain tract of land with a water right attached.

(5) The method of management by which this would be accomplished would be much less complicated and expensive than is possible under the district system. In order that a district organization may be effected so as to result in the ownership and control of individual works by those served under them, we have seen that a complicated management is necessary. This management consists of a board of trustees, assessor, treasurer, tax-collector, and frequent mass-meetings of the landholders within the district. The support of this intricate mechanism is a heavy charge upon the taxpayers of the district; indeed, it may be doubted as to whether a water rental is not a lesser evil than individual proprietorship under such conditions. Modern capitalistic

enterprise, on the contrary, reduces the cost of management to a minimum, and, in the case in point, by a simple process of sale and delivery would insure the settler the land with the water right attached.

(6) The works for delivery and distribution constructed by corporations operating under State supervision would be more efficient and durable than those constructed by the landholders themselves. According to the provisions of the plan suggested, the board of control would have the power to approve or disapprove of any irrigation works proposed by the company and to supervise the works while under process of construction. This would not only compel the company to construct such works as a competent body of engineers and irrigators might think necessary, but also to construct the works in accordance with the original specifications.

(7) A reliable company could conduct its enterprises on a large scale, and would not be crippled for want of funds. The only limit to its expenditure would be the construction sum specified by the State minus a reasonable profit. On the other hand, the limit of the expenditure of an individual irrigator would be determined by the yield and value of his crop, both variable quantities; hence, there would never be any assurance that the funds for the necessary works could be raised.

Besides the economic justification for the plan of granting the lands to construction companies to be reclaimed by them, the history of the marked improvement during the capitalistic era of irrigation in Utah would seem to designate such a course as a wise one.¹ Through the agency of safe, conservative irrigation corporations the estimated value of

¹ The period from 1890 to the present time is designated the capitalistic era of irrigation in Utah, because the principal characteristic of this period has been the growth of irrigation corporations, involving the investment of capital, as opposed to the earlier co-operative system of irrigation, in which communities banded together for the construction of the necessary irrigation works, and labor constituted the sole basis of stock in every canal.

the land has become greater, the water rights appurtenant to the land more secure, the acreage product larger; that better markets have been opened up by reason of a qualitative improvement in the farm produce, that improved agricultural implements have been introduced, that cheaper transportation rates have been secured, and finally, that factories have been established for the utilization of the by-products of the farm. The theory once prevalent in Utah that a corporation is a mass of watered stock no longer squares itself with practical results, and should be discarded by those who seek the development of the new State's possibilities. In weighing the relative merits of the plan suggested, the reader should consider the successful history of corporate effort in Utah for the past eight years, and also the fact that in granting the remaining irrigable lands to private corporations for reclamation the people's heritage would be managed by safe, legitimate enterprises.

There would seem to be only one objection to the plan presented, and that is apparent rather than real. To vest such large powers, almost judicial as well as administrative, in a board of control composed of a few men would seem at first sight to jeopardize the interests of "irrigation socialism," when the very object of the board's creation would be the restraint of "irrigation autocracy." But it must be remembered that this board would be composed of men thoroughly identified with the irrigation interests of their respective sections of the State and would be the agents of a sovereign constituency.

CONCLUSION.—In its final analysis irrigation as an economic problem is composed of five parts: (1) An adequate water supply. (2) Suitable lands to put it on. (3) Efficient and lasting works for delivery and distribution constructed within economic limits of cost. (4) A fair and efficient management of those works in the interest of the consumers under them. (5) A contented, industrious and skilful population of irrigators located on the land. The union of these

five parts into a well-rounded whole is necessary for the success of any irrigation enterprise; hence, that method of reclamation is to be accepted as the best which accomplishes this union in the most satisfactory and economical manner. That both federal and state action are necessary to secure this result should be conspicuously apparent from what has been written; but beyond the legitimate and necessary steps to transfer lands to the proper authority, to control and promote enterprise for social and economic reasons, and to conserve the public water supply, neither state nor federal authority should go. Neither are the five great parts of irrigation existence to be brought together by community action alone. In some cases there are agricultural neighborhoods where two of the parts are already united—the land and the people—and then conditions are favorable for the district experiment. But even granting these conditions, which do not obtain in the case of Utah's irrigable lands, there is no assurance that an adequate water supply will be secured to the district taxpayers, and that the board of trustees will manage the district works with fairness to the large prior appropriators under them.

Speculative enterprise, hedged about by such conditions as will prevent autocratic control, seems to be the only rational solution of the irrigation problem. This theory finds its embodiment in the plan suggested in this monograph, that the State should grant its irrigable lands to private corporations, that these corporations should construct the necessary works under state supervision for a specified sum, and finally, that the land so reclaimed should be sold to individual settlers, the reversion remaining in the State in trust.

CHAPTER IV.

STATE CONTROL OF WATER.

A remedy for the evils accruing from the abuse of the priority of rights system has been anticipated in the suggestion that the supervision, protection and control of the waters of Utah should be vested in a State Board of Control, composed of the state engineer, representative irrigators from different sections of the State, and a secretary well versed in irrigation law.

The idea of a water court to adjudicate water rights and to protect those irrigators who have not taken out prior rights is not a new one. "For six hundred years," says Professor Fortier of the Utah Agricultural College, "the Valencian irrigators of Spain have settled their water question with little or no expense through the peasant courts, which hold weekly meetings in the Cathedral squares."¹ Instead of appointing a water court for each community, as did the Moors, the writer would go one step further and recommend the appointment of a general court for the whole State. State control of water antedates in antiquity the Justinian code and, as we have seen, is the fundamental principle of the civil law of water rights. Wyoming, in creating a board of control in 1891,² merely imitated the administrative procedure of every European state where irrigation is practiced.

The right of the State to control the waters within its boundaries is a translation of the theory that water is public property, and that the right to its use is the only right that can be acquired by a private individual. While the

¹ Report of Utah Irrigation Commission to the Third National Irrigation Congress, Denver, 1894, 44.

² Statutes of Wyoming, 1890-91, Secs. 19-39.

use of running water may belong to a private individual, the law holds that the thing itself, the corpus of the water, can never be appropriated. The right to the use of the water is restricted to the reasonable wants of the individual, and is held subject to the great fundamental principle of "not interfering with the rights of others." In the Arid Region water may be filed upon and appropriated for a beneficial public use, and not for a purely private purpose; that is, the person or company filing upon and appropriating, acquires a right to the beneficial use of the water filed upon and appropriated to the exclusion of all others, in return for certain public benefits conferred. But the rights thus acquired, according to law, are merely an easement in the use of water and not an ownership thereof.

Irrigation corporations differ in this respect from many other corporations carrying with them a public beneficial use, such as railroad companies for instance. The reason why irrigation corporations differ from railroad corporations is because of the nature of the substances or objects with which they deal. Railroads deal mainly with land, which is subject to private ownership and control, and they secure either an easement to the use of land or the title to the land itself by condemnation under the power of eminent domain; while irrigation companies deal principally with water, which is not subject to private ownership and control.

All the abuses and injustices of the priority of rights system in Utah have resulted from a belief that the water in its streams is private merchandise, a speculative commodity to be bought and sold without regard to the public interest. The prior appropriator has come to regard an appropriation of water in much the same light as he regards acquiring title to land, and looks on nothing less than absolute ownership as his just share. There is nothing in the use of water for irrigation which justifies this claim.

The whole doctrine of prior appropriation in Utah grew out of conditions of the country which made it necessary that the water of its streams should be diverted and absorbed

in order to secure material development. The return which came from the use of this commodity to the State caused the State to make a surrender of its interests. The protection of the appropriator in his right "to use" has been due to the fact that the waters of the State's streams would not serve all the land bordering them. If there had been an abundance of water for all possible users, it is safe to say there would have been no necessity for the doctrine of priority of right or any right of appropriation whatever. For had all been supplied, it would have availed nothing to determine who had the best right; but, inasmuch as the supply was inadequate, it became necessary for the State to determine who had the best right to its enjoyment, and to protect that right in times of scarcity. In Utah it was declared that the first users had the best rights, and that the rights should be reckoned in their order upon the time of use. This free grant from the State to the individual has been fraught with abuses, a consideration of which will suggest some of the advantages of the control of water by a state board. Among the abuses which have arisen are:

(1) Appropriations have extended beyond the limit of the necessities of the prior users, involving an injustice to the subsequent users.¹ There has been no law in Utah defining the duty of water, and hence no limit to the maximum appropriation allowed. The provision that a continuous failure to use water for a period of seven years means the forfeiture of the right has extended the margin of waste over an undue length of time. Where water is so necessary to material development and individual pros-

¹ The Supreme Court of the State recently rendered a decision which will go far towards righting this abuse. In the case of John Hague vs. the Nephi Irrigation Company the important rule was laid down that a prior appropriation of water is only good to the extent of such an amount of water as can be used by the appropriator for beneficial purposes. In other words, the court holds that if a man attempts to appropriate any amount of water in excess of what is sufficient for his use, the excess would be subject to appropriation by other parties.

perity, the right to use should be forfeited on proof of two years' disuse.

That a large amount of water is wasted under the pretext of prior appropriation is obvious from the following propositions:

(a) In 1896 the total area of land under ditch in Utah was 1,035,226 acres.

(b) The area of the Great Salt Lake is 1,200,000 acres, and it is dependent for the maintenance of its status upon the surplus over the ability to irrigate these 1,035,226 acres.

(c) It is declared that all the waters which feed Great Salt Lake are appropriated and in use. Now, the standard requirement of irrigation water is a cubic foot per second foot. In other words, an acre of water one foot deep is needed for each acre of land. Suppose none of this water flowing in the streams were to be directed on the farm, but were all allowed to run direct to the lake, how much would it add to the depth of the lake? The answer, according to reliable scientific information, is just $2\frac{1}{2}$ inches. How, then, is the status of the lake maintained in spite of the enormous summer evaporation? There can be but one answer—it is maintained by the water appropriated and thought to be in use, but really running waste.

(2) Laxity in the administration of the law of priority of rights has encouraged the accumulation of large surpluses of water for purposes of sale, as well as waste in the use of water. The accumulation of water for sale finds no justification in the theory of appropriation, because the law recognizes the right of appropriation as restricted, not only to the use for which it is acquired, but also to the place where it is acquired. So prevalent has the idea become, however, that the right to use is a property right and transferable, and so few have been the restrictions by which the appropriations have been hedged about, that many prior appropriators have acquired a comfortable competence from traffic in water. It has frequently happened that such large quantities have been withdrawn and hoarded for this pur-

pose as to defeat all secondary and tertiary rights on the stream. This is especially true where the lands of prior appropriators are situated on the upper part of the stream. Provision should be inserted in the priority law fixing the maximum amount of water for each acre to be irrigated, and absolutely prohibiting the hoarding of water by any appropriator for purposes of sale.

(3) The sale of water by the prior appropriators has frequently resulted in a divided ownership of land and water. The Utah priority law provides, in case of a sale of land, that a right to the use of the water appurtenant thereto shall pass with the land to the grantee; but strangely enough fails to make provision for undivided ownership in case of the sale of the water. Conditions have thus arisen under which a man can own the water of a stream and dictate to users the terms on which it can be had.

(4) The transfer of appropriations from one portion of the stream to another has prevented efficient divisions among appropriators. It is a well-known fact that the water diverted from a stream to be used in irrigation is not wholly lost. A large percentage returns to the stream as waste water, or by percolation through the soil. In some instances 50 per cent of the water first diverted from the streams returns to be used by the appropriators below. If A, B, and C are appropriators from a stream in the order named, the water which is available for B is not what remains after the diversion by A, but what remains plus what returns to the stream after use by A. The water which is available for C is not alone what is left of the original volume after diversion by A and B; on the contrary, none may have been left in the stream, his entire supply may come from the water returned to the stream after its use by A and B. This being the case, it follows that after irrigation has continued on a stream for a number of years, an equilibrium should be established. But under the priority of rights system, as it has been administered in Utah, appropriations on a stream have been changed from year to year,

and there has rarely been an equilibrium of supply as between the different appropriators. Water diverted by A, the prior appropriator, has frequently been diverted and used above the point where C's diversion should have taken place, and thus C has been shut out altogether.

(5) The interests of Utah's irrigators as a body have been unequally protected, thus preventing the fullest utilization of the water supply. There are several rights growing out of the diversion and use of the water of a stream. There are the rights of those who construct canals to transport water; these are the rights which belong to carriers alone. There are the rights of those who build reservoirs to impound water, which may be called rights of storage; and there are the rights of those who apply the water to any beneficial purpose, or user rights. The priority of rights system has given undue protection to the holder of user-rights. This followed as the logical sequel of the early union of the rights of carrier and user in the same person. But conditions have changed; canals and reservoirs have been constructed to store water for hire. The rights arising from this differentiation of the functions of carrier and user should be protected, in order to afford capital the necessary security for investment.

A review of these abuses reinforces the necessity for state control of water as an essential modification of the priority system. Specifically stated, the advantages of the creation of a state board of control would be:

(1) A board of control, by ascertaining how much water is available for irrigation and how much is necessary for the use of prior appropriators, could so regulate its distribution that both a surplus and a waste would be prevented, and at the same time the prior appropriator would be protected in his rights. On the one hand, the board could prevent appropriations of water in excess of actual requirements; on the other, protect the rights of those who lawfully appropriate.

(2) A board of control, by refusing to recognize the

validity of water sales, could destroy the practice of making water a speculative commodity and, as a sequel, maintain the undivided ownership of land and water. Even if the present law was amended so as to prohibit the accumulation of a surplus of water by prior appropriators for purposes of sale, it would be inoperative unless enforced by some state administrative body.

(3) A board of control, by supervising the location and erection of irrigation works, would insure their permanence and strength and protect the public from a repetition of Johnstown flood disasters. The best engineers in the country state it as their opinion that the plans and specifications of all new reservoirs should be approved by a competent commission, and that the construction of all new dams and the stability of all existing ones should be made more secure by a periodical inspection by competent officials in whom sufficient authority should be vested to order the necessary repairs.

(4) A board of control would furnish a cheap and efficient water court. The number of irrigators in Utah possessing an undisputed legal claim to water may be counted by the dozens, while the lands remaining unsettled run up into the thousands. There is a law on Utah's statute books giving the selectmen of each county the power to decide disputes, but this law has long since become inoperative, and for many years past the only practical means of settling a disputed title to a water-right has been through the district courts. The large majority of the farmers of the State are opposed to this means of acquiring titles to water-rights for the following reasons:

(a) It is too costly. To be obliged to set in motion all the machinery of the district courts in order to determine how much water flows in a particular stream, how much land it irrigates and the legal owners of the water is an unproductive expenditure of the irrigator's substance. Prof. Fortier tells of a recent irrigation case costing the litigants \$13,000, and all parties to the suit agreed that it

was not properly settled and that in the course of time it would have to be fought over again. If the money spent in litigation was devoted to the building of reservoirs, the prosperity of Utah would be much increased. The present system is costly, owing to the large fees to be paid to lawyers, the expenses incident upon court proceedings, and the large amount of time and money expended in bringing farmers sometimes long distances to await their turn to testify.

(b) It requires too much time. The dockets of Utah's courts are overcrowded, and court procedure is necessarily slow. A suit begun in 1897 will have a referee appointed in 1898 and perhaps a decree issued in 1899.

(c) The decrees are unsatisfactory. A perusal of the testimony in the water cases in the West would reveal the fact that men will exaggerate even under oath, and the present system in which attorneys, instead of a referee or judge, question the witnesses seems to encourage this evil. It is a fact, too, that the decrees are based almost wholly on such testimony. Far too little importance is placed upon the collection of physical data by disinterested parties. Yet the most essential portion of the evidence upon which to base a decree consists in the volume of water diverted and the use that it subserves.

The increase of the actual water supply by judicial decree has become very prevalent in the Arid Region. A case is on record in Idaho where a litigant was awarded 800 inches of water in a certain ditch in which nature had only put 100; and numerous other cases could be cited to prove the unsatisfactory character of district court decrees. In general, it may be said that the existing decrees have no particular basis for the amounts decreed, except that each claimant is allowed all he claims, regardless of what effects it may have on other rights.

The weak points of the district court system are the strength of state control. With all the facts pertaining to both the lands and waters of a certain watershed collected,

mapped and tabulated, the necessity for testimony would be obviated, thus saving time and money to the parties at suit. The State would not necessarily have to wait for controversies and losses to arise, but of its own motion could step in and ascertain how much water was available for irrigation, who were the claimants to this water, and then, knowing these fundamental facts, could give the use of the water to the proper persons and employ its own agents to see that the distribution was made.

The only possible objection that can be urged against the creation of a board of control is the danger of centralized power. But this could be met by a provision for appeal to the courts by any party feeling himself aggrieved, and by a further provision that when the case is finally decided the right of the prevailing party shall date back to the first step taken by him to secure his right.

The success of the experiment of state control in Wyoming, where over 2500 claims to water have been adjudicated within a period of four years, presents a strong historical precedent for its adoption by the irrigators of Utah.

CHAPTER V.

NECESSITY FOR MORE ACCURATE MEANS OF MEASURING WATER.

The practical need for accurate methods of measuring and appropriating waters is fully as urgent in Utah as the control and distribution of these waters. In fact, without the first reform, the second would be impossible. After half a century of progress in the diversion and beneficial use of water the various quantities should no longer be a matter of guesswork. In this connection Professor Fortier estimates that by a simple and cheap structure it would be possible to measure and apportion all irrigating waters within a maximum error of 4 per cent, and to so adjust and arrange the gauge or graduated rod of the measuring apparatus that any intelligent irrigator after noting the gauge could determine the volume in second-feet which flowed past it.¹

The writer would suggest that plans and specifications for the construction of proper head-gates, measuring flumes and weirs might be prepared either by the State Engineer or the Experiment Station of Utah and forwarded with the necessary instructions to the commissioners of each county, and that these county boards might be charged with the supervision of their construction and maintenance, the costs in each county to be distributed among the various individual and corporate water-right owners. After such a measuring flume or weir is placed in each canal, it should be rated and gauged by some competent person in the employ of the State. If the water which was conveyed through each ditch or canal was properly measured as near

¹ Article in Salt Lake Tribune, Jan. 1, 1898.

to the head-gate as practicable, and if the State would at the same time keep a continuous record of the flow of all natural streams, at properly constructed gauging stations, many of the difficulties that now harass the irrigators would be removed. Ever since the first settlement in Palestine litigation has proved the curse of all irrigated countries, and litigation arises chiefly from careless methods of appropriating water. In this respect Utah is no exception, and the writer is of the opinion that the money saved to the State in lessening the number and cost of the lawsuits would in a few years pay the cost of suitable measuring devices.

Owing also to the absence of all accurate knowledge as to the volumes carried by canals, much of the testimony taken in water cases is of little value and has perhaps no bearing on the case. Again, after decisions have been handed down the parties in interest have no assurance that the volumes decreed will be delivered to the respective parties. The custom of guesswork is followed after the decision just as it was before. The court, it is true, may define a channel as so many feet wide and of a given depth, but unless the mean velocity is stated it is equivalent to defining the tonnage of a hay-stack by describing its base without any reference to its height. This question of velocity is of prime importance, inasmuch as any slight change in the conditions affects it. Engineers have estimated that the growth of moss may reduce the speed of the moving water 80 per cent, or some modification of intake dam or head-gate may make a difference of 30 or 40 per cent.

In the wide range of irrigation practice there is perhaps no question so difficult of solution as the quantity of water necessary to irrigate an acre of land. And yet in the settling and apportioning of irrigating water among the various claimants, it is often necessary to adopt some general standard for the duty of water. So many conditions affect the volume needed that it is only by taking the average of a large number of individual tests that one can arrive at

any just estimate. The cultivated soils differ so much in texture and materials that the amount of water which would create a lake on a retentive clay soil might be scarcely enough to produce good crops on porous, gravelly bench lands. Thus a vast amount of water runs to waste in Utah because there are no measuring flumes or weirs to determine the capacity of its streams and also because of ignorance as to the amount of water required to irrigate lands.

These considerations lead the writer to suggest that the next Legislature make an appropriation competent to cover the cost of measuring devices and to defray the expense of determining the average amount of water required in different sections of the State.

CHAPTER VI.

THE MARKETING OF IRRIGATION PRODUCE.

With increased production through irrigation, the problem of marketing produce not wanted for home consumption has become vital. In this connection, we have seen that the irrigators of Utah are suffering from the evils of the commission system, especially in the marketing of fruit.

This system encourages the anomalous evils of discriminating combination and cut-throat competition. Middlemen combine and by virtue of their absolute control of the market are enabled to dictate their own prices for picking, packing and shipping, and even to charge a commission on the gross price at which the fruit sells in the market. The usual charges are from thirty-five to fifty cents for picking and packing and a commission of ten to twelve per cent on the gross proceeds for shipping and selling.

A typical instance of the advantage taken of the fruit-grower by the fruit-dealer is seen in the small profit of twenty-three cents accruing to the producer of a box of cherries which nominally net one dollar in the market after transportation charges are paid. Of this net sale the middleman exploits 77 per cent, the charges and selling price being itemized as follows:

Gross selling price	\$2.00	
Picking and packing....	\$0.43	} 0.77
Cartage and warehouse... .	.10	
Commission .....	.24	
Transportation charges...	1.00	
	<hr/>	<hr/>
Total charges	\$1.77	\$2.00
Profit to grower .....	.23	
	<hr/>	<hr/>
	\$2.00	\$2.00

If the consumers were reaping any benefit from the small profits realized by the grower, the evils of this commission combination would be in some measure neutralized by a corresponding good. But the fact is that Utah fruit commands a good price in the eastern and northern trade centres where it is shipped, and that increased consumption has not to any appreciable extent reduced prices. And again, while freight charges were extraordinarily high when fruit shipments from Utah were first made, competition between railroads and a large increase in traffic have brought about large reductions, in addition to increasing the transit time from the slow freight service of a few years ago to the fast passenger service of the present date. Favored by stable markets and cheap transportation charges, we should normally expect a combination of middlemen to realize a fair remuneration for their services and at the same time to confer measurable benefits upon the grower by reason of cheapened management and the operation of the wholesale principle. Not so, however, for while the middlemen combine to fix extortionate charges upon the grower, there is no semblance of a pooling agreement among themselves, looking either to the division of traffic or of territory. In this ruinous competition between splendidly equipped business rivals, certain markets are flooded with fruit, while others less attractive are entirely neglected. When the natural congestion following the rushing of say ten carloads of fruit into a five carload market sets in, the commission men begin to belabor one another, using the growers as clubs with which to beat their business rivals. This invariably leads to a stoppage of production commensurate with the demands of the market, and thus places artificial limits about further irrigation progress.

The remedy for the evils of this system is to be found in the application of the primal principle of Mormon colonization to exchange organization. *Co-operation among the growers themselves in shipping and marketing, by which the dealer is made identical with the grower and the grower with*

the dealer, seems to the writer to furnish the constructive principle of a better exchange mechanism.

A specific plan by which this principle might be successfully applied would seem to be the following: All the growers in one locality to form an association, selecting a local name for it and electing a board of directors and a manager. Each association manager to be a member *ex-officio* of what is to be known as a County Exchange. This County Exchange to be incorporated under the state law, and the members of the local associations to be recognized as members and stockholders in the County Exchange, their voting power being proportionate to their fruit acreage. These exchange officers to control the output of their several associations, suggesting points to which shipments shall be made and, as a corporation, guaranteeing the contents of every box of fruit bearing their individual exchange brand. These county exchanges to be in turn controlled by a Central Co-operative Fruit Exchange, really an executive committee composed of the members of each county or sectional exchange. This central organization should be in daily telegraphic communication with every fruit market in the United States, its shipments to the various markets being so regulated that only a reasonable supply of fruit could be shipped to any one market. In order to meet the opposition of commission men who, under favorable conditions, might underbid the Exchange on its own ground and sell in Eastern markets at a lower rate, the Exchange should send a reliable agent to the Central-eastern markets, guaranteeing the safe arrival of the fruit and in every instance warranting the fruit to be strictly as graded by the box marks. The obvious *merits* of such a plan are:

(1) The grower would be insured a larger share in the proceeds of his industry and at the same time his dealings with the eastern consumer would be carried on under an efficiently organized commission system. The offices of dealer and grower being performed by one and the same person, the grower would be charged only actual cost in

selling and handling the fruit, and would be exempt entirely from the iniquitous charge on the gross price at which the fruit sells in the market. And under the provisions of this plan, the Exchange would employ jobbers and retailers to handle the fruit in the eastern market and place it directly in the hands of consumers, thus constituting a commission system the agents of which would be the producers themselves.

(2) There would be a greater incentive under the co-operative system to regulate price by the law of supply and demand rather than by speculative competition. A commission system of growers seeking to realize the greatest aggregate profit over a long period of time would likely place the fruit on the market at the opening of the season at a low figure, and then slowly advance the price as the quality of the fruit improved and the consumption grew stronger; while experience has proven that a commission system of dealers short-sightedly market their goods early in the season at monopoly prices and afterwards at cut-throat competitive prices, thereby making demand inelastic and curtailing consumption.

(3) Under a co-operative exchange the system of rejections could be suppressed. Under the present system an eastern dealer who orders a carload of fruit by wire does not feel compelled to take it if he discovers after placing his order that he can buy a similar grade cheaper from some other shipper. Nor is the shipper the only loser by these rejections, for it frequently happens that the dealer who tries to take advantage of the shipper is crippled in the attempt. The fruit-grower shipping the fruit to a certain market, possibly small and limited, and finding after the fruit has started that the dealer who had ordered it would refuse to take it on arrival, hastily wires some opposition dealer in the same place of the facts and offers him the fruit at a price much lower than that for which it was originally sold. This kind offer is usually accepted, and results in glutting a market with two shipments of fruit

when it only demands one. Thus the system of rejections means a loss to both the grower and the original purchaser.

It could easily be provided by the Central Co-operative Exchange that any fruit-dealer ordering a car from one of the local exchanges and refusing to accept it on arrival, except for bad order, should be promptly black-listed by the Central Exchange, and could not purchase any fruit from any exchange or association until he has settled for the rejected fruit. "In California," says a prominent writer on irrigation subjects, "co-operative exchanges have become so formidable that no fruit-dealer would attempt an old-time rejection unless he contemplated going out of the business very soon thereafter."¹

The writer apprehends that the only *difficulties* preventing the formation of co-operative exchanges in Utah would be:

(1) The difficulty of organizing growers solidly on the co-operative basis, so as to subordinate individual jealousies and ambitions to the good of the whole.

(2) The determination of the method of handling the fruit and the status of the individual grower in the local association.

The first difficulty would doubtless be overcome by the feeling of solidarity and mutual assistance inherent in the Mormon industrial and religious systems, a feeling conceived in the initial hardships of colonization and strengthened by tests of toil.

The following plan adopted by the local fruit associations of California would seem to remove the second difficulty when applied to Utah conditions: All the fruit belonging to the members to be pledged to and placed under the absolute control of the managers of the local association. The fruit to be picked at such a time and in such quantities as the manager determines, this being done by the grower himself, who is to deliver his fruit at the packing house in

¹ Fred. L. Alles, California Fruit Exchanges. Article in Irrigation Age, Nov. 1895.

such quantities as are called for. The fruit to be weighed on delivery, is then to be carefully graded into "Fancy," "Choice," and "Standard," and assorted according to sizes. The damaged and over- and under-sized fruit to be rejected as culls and charged back to the grower. The grower to receive credit on account for a certain number of boxes of each size or grade which he furnishes for the carload or shipment for which his fruit is packed. All boxes of his fruit are to be marked with his individual number and the car is to go to the market directed by the Central Exchange. When the returns from that particular carload are in, all charges for selling, freight and packing are to be deducted and the balance is to be placed to the credit of the growers, who are to check against it at once.

These considerations would seem to justify the practical application of the co-operative principle in the marketing of irrigation produce. For not only does this principle possess theoretical advantages of unquestioned validity, but in California, where it has suffered the opposition of brokers and merchants and the distrust of dealers and shippers, its merits have received a triumphant vindication. Consonant with the genius of Utah's colonization and early industrial enterprises, and insuring the intelligent organization of growers for self-protection, co-operation appeals to the writer as the most effective remedy for the evils of a commission system of dealers.

The co-operative exchange may be only one of the many means of righting existing wrongs; certainly the remedy proposed is not to be rigidly considered as the only outlet of escape. The evil is great and must be corrected. For while Utah's railroads grant competitive and non-discriminating rates, the great transportation agency between producer and consumer, the Utah middleman, pools the traffic and exploits gains granted to the irrigator by virtue of the bounty of the soil and the certainty of the crops.

APPENDIX A.

UTAH'S WATER SUPPLY, STORAGE RESERVOIRS AND AMOUNT OF IRRIGABLE LANDS.

Utah belongs to the great plateau of the Rocky mountains, its valleys being elevated from 2700 to 7000 feet, while its mountain peaks reach a height of 12,000 to 13,000 feet above the sea. About one-half of the State is on the western side of the Wasatch mountains, and within what is called the Great Basin. This basin occupies western Utah, nearly all of Nevada, and parts of California, Oregon and Idaho. It has no outlet, the drainage being towards two great depressions where there are salt lakes, one of which, on the western side under the Sierra Nevada mountains, is the Great Salt Lake.

There are many other minor lakes that receive the drainage of small areas that do not flow into either of these depressions, but geologists say that once they all flowed into one or the other of them. These lakes have no outlet, and the water flowing into them evaporates by the heat of the sun. The average elevation of the Great Basin is from 4200 to 5500 feet above the sea level. Most of the inhabited portion of Utah, and a small portion of the southern part, lies on the western side of the Wasatch mountains and on the eastern side of the Great Basin. The eastern half of Utah, and a small portion of the southern part, lie on the west side of the Wasatch mountains, and belong to the drainage of the Colorado river and its tributaries. Its valleys range from 2700 feet on the south to 7000 feet on the north. The eastern part of the State is drained by the Colorado and its tributaries; the western part by streams that head in the Wasatch and the high plateaus of the central part and find their way into the Salinas and the desert

sands of the Great Basin. Thus we have the Colorado drainage area and the Desert drainage area within the drainage systems above mentioned.

In order to determine the location and the amount of Utah's irrigable acreage, it is necessary to further subdivide the Colorado and Desert drainage systems. The Colorado drainage system may be said to consist of: (1) The Salt Lake system, stretching from Utah Lake through the valley of the Bear river, along the line of the Wasatch range. (2) The Colorado drainage system proper, including lands watered by the Colorado, San Juan, Price, Grand and Green rivers. The Desert drainage system may be said to consist of: (1) The Sevier River Valley drainage system. (2) The drainage system of southwestern Utah.

In general, it may be said that the topography of the State is favorable to irrigation. Utah's farming valleys may be appropriately compared to cisterns; its mountains, to roofs upon which the storm descends; its canyons, to eaves-troughs collecting the waters and carrying them to the thirsty valleys below. A mountain valley traversed by a creek or river and terminating in the almost vertical walls of a rugged canyon is the rule rather than the exception throughout the general configuration. Sites have been found in these valleys where reservoirs, from 120 to 150 feet high and with capacities from two to three million gallons, could be constructed at a total cost of not more than \$70,000, or at the rate of about \$12 per acre for the land watered.¹

As storage has been said to be the solution of the problem of providing adequate supplies of water during the irrigation season, it will be well to speak in more detail regarding the larger reservoirs of the State, both those built and the ones projected. The reservoirs of the Mt. Nebo Land and Irrigation Company and the Lake Bonneville Water and Power Company have already been described. The Swan Lake reservoir covers nearly 8000 acres of

¹ Samuel Fortier, *Irrigated Utah and its Needs*, a paper submitted to the Third National Irrigation Congress.

ground and stores about 50,000 acre-feet of water. This reservoir has nearly eight miles of artificial banks, ranging mostly from 2 to 18 feet in height.

The Gunnison reservoir in San Pete county at present covers between 400 and 500 acres of land to an average depth of 10 feet, and has a dam 20 feet high by 300 feet long.

The Beaver Land and Irrigation Company's reservoir in Beaver county has never been completed, but is designed to cover an area of about 2500 acres to an average depth of 9 feet. The length of the dam would then be 1800 feet, of which only 250 feet (that taken up by the channel of the Beaver river) would be 25 feet in height.

The Snake Valley Land and Water Company's reservoir in the extreme western part of the State is designed to irrigate 50,000 acres. It is formed by blocking up a gorge with a masonry dam 45 feet high by 200 feet long, thus converting an old lake-bed into a reservoir two miles long by half a mile wide and nearly 100 feet deep.

Of the large reservoirs at present projected for Utah, that of the Pioneer Electric Power Company at the head of Ogden canyon is the most prominent. This reservoir will have a masonry band about 400 feet long by 60 feet high, and will cover 1200 acres to an average depth of 25 feet.

Another new reservoir for lands tributary to Ogden is the one in East Canyon in Morgan county, now being built by the Davis and Weber Counties Canal Company. By a rock-filled dam 60 feet high, 150 feet long on top by 80 feet at the bottom, a reservoir about three miles by one-half a mile will be formed. The dam will have a heavy layer of earth or a wall of plank on the upper side to prevent or reduce the leakage.

About 8 miles east from Fairview in San Pete county is the site of the Mammoth reservoir. This is on Gooseberry Creek, and by an earthen band with masonry core, 600 feet long by 120 feet high, across the creek, a lake $2\frac{3}{4}$ miles long by $\frac{3}{4}$ of a mile wide and holding 35,000 acre-feet can be formed. The water from this can be conducted

by a tunnel $1\frac{1}{2}$ miles long through the Divide to the west slope, to irrigate about 30,000 acres in San Pete valley.

At Hebron, in Washington county, is now being constructed a reservoir that will hold about 5500 acre-feet. The outlet of a basin about 1 mile long by $\frac{1}{2}$ mile wide is being closed by a dam 80 feet high, 66 feet long at the bottom and 130 feet at the top. The dam is now completed to 25 feet high. The back will be a masonry wall 20 feet wide at the bottom and 8 feet at the top; in front of this will be a bank of earth for preventing the water reaching the wall. This earth bank will be 170 feet wide at the bottom.

The reservoirs of the Taylor Irrigation Company, situated in Juab county, cover 212 and 325 acres, respectively, and hold 12 feet of water.

The double reservoir of the Marysvale Reservoir Company, on the Sevier river, it is estimated will add 30,000 acres to irrigable area when completed. The area of the reservoir will be about 1400 acres.

The Clear Lake Land and Irrigation Company has been constructing their irrigation system near Clear Lake, in Millard county. The beginning of their reservoir is a sheet of water called Clear Lake, fed by nearly 200 springs issuing from the lava formation around the sides, and it has developed that there is a large underground storage of water when it is raised high enough to overflow the spring. By a system of dikes, a reservoir covering 1400 acres to an average depth of 5 feet is formed. A canal 10 miles long is in process of construction which will conduct the water to the land to be reclaimed lying along the Oregon Short Line Railroad.

In addition to these reservoirs, 13 reservoir sites have recently been segregated by the United States Geological Survey,¹ so the outlook for a better utilization of Utah's water supply than heretofore seems bright.

¹ The Utah Lake, for which alone 125,000 acres were segregated, was one of the sites selected. The total number of sites selected in the Arid Region was 190.

TABLE SHOWING THE IRRIGABLE LANDS IN UTAH.¹

I. Salt Lake Drainage System.

Names of Rivers and Streams.	Irrigable Lands. Acres.
Base of Uinta Mountains.....	8,000
Yellow Creek and Dry Creek.....	6,200
Randolph Valley and Salertus Creek.....	110,000
Shores of Bear Lake.....	28,800
Cache Valley	400,000
Bear River Delta, Malad Valley.....	368,000
Box Elder Valley (Mantua)	1,960
Weber Valley	35,760
Parley's Park	5,048
Uptown	8,280
Echo Creek	2,152
Croydon	940
Round Valley	1,940
Morgan Valley	22,416
Ogden Valley	12,800
Weber Delta Plain	280,320
Kamas Prairie	16,320
Hailstone Rancho and vicinity.....	3,280
Provo Valley	41,000
Waldsburg	2,460
Utah Valley	270,000
Salt Creek	23,480
Salt Lake Valley (including Bountiful)...	274,760
Tooele Valley	65,000
Cedar Fort	3,000
Fairfield	1,800
Vernon Creek	2,700
	<hr/>
	1,996,416

¹ By irrigable lands is meant lands that could be irrigated if the water supply were properly utilized by the construction of storage reservoirs and scientific methods of diverting the waters of the rivers and their tributaries.

Names of Rivers and Streams.	Irrigable Lands. Acres.
Amount brought forward	1,996,416
Saint John's	1,750
East Canon Creek (Rush Valley).....	2,000
Stockton	1,250
Scull Valley	6,250
Government Creek	1,000
Willow Spring	750
Redding Spring	400
Dodoquibe Spring	125
Deep Creek	3,000
Pilot Peak	520
Grouse Valley	3,500
Owl Spring	4,000
Rosebud Creek	50
Muddy Creek	900
Park Valley	7,600
Widow Spring	140
Indian Creek	300
East Base of Clear Creek Mountains.....	150
Cazure Creek	400
Clear Creek	400
Junction Creek	2,100
Goose Creek	600
Pilot Spring	30
Desert Creek (or Deep Creek).....	10,000
Crystal Springs	500
Antelope Springs	160
Henzel Springs	15
Promontory, east base	2,020
Blue Creek	4,800
Brackish Springs, near Blue Creek.....	3,500
Antelope Island	150
Total	2,054,776

II. Colorado Drainage System Proper.

Names of Rivers and Streams.	Irrigable Lands. Acres.
Virgin River	45,700
Knab Creek	3,600
Paria River	7,200
Escalante River	22,250
Fremont River	53,000
San Rafael River	336,000
Price River	15,080
Mumie Maud Creek	5,760
Uinta River	364,800
Ashley Fork	48,000
Henry's Fork	12,800
White River	114,000
Brown's Park	18,200
Below Split Mnt. Canyon (Green River) ..	110,000
Gunnison Valley (Green River)	23,000
Grand River	75,800
Total	1,117,180

III. Sevier Valley Drainage System.

Names of Rivers and Streams.	Irrigable Lands. Acres.
San Pete Valley	80,000
Gunnison	12,000
Sevier Valley, above Gunnison	150,000
Circle Valley	13,500
Panguitch and above	28,000
Total	283,500

IV. Southwestern Drainage System.

Names of Rivers and Streams.	Irrigable Lands. Acres.
Cherry Creek	500
Judd Creek	500
Levand	6,000
	7,000

Names of Rivers and Streams.	Irrigable Lands. Acres.
Amount brought forward	7,000
Scipio	5,100
Holden	3,000
Filmore and Oak Creek	10,500
Meadow Creek	3,600
Canosh	6,000
Beaver Creek and tributaries	42,000
Paragoonah	3,000
Parowan	3,000
Summit	1,200
Cedar City, Iron City and Ft. Hamilton..	9,200
Mountain Meadows	600
Pinto	600
Hebron	3,000
<hr/>	
Total	97,800

RECAPITULATION.

Salt Lake Drainage System	2,155,520
Colorado Drainage System Proper	1,117,180
Sevier Valley Drainage System	283,500
Southwestern Drainage System	97,800
<hr/>	

Grand total irrigable lands in Utah....3,654,000

Whatever conditions future developments may bring about, the present water supply of Utah is surface. It depends entirely upon the fall of snow in the winter, and to a slight degree upon the rainfall during the spring and fall months. And not only is the success of any farming experiment dependent upon the *amount* of the snowfalls in the mountains, but upon the *time of the year* in which it occurs.

If the snow falls early in the winter, it usually becomes hard and does not melt until the heat of summer has become intense and the needs of the crops are the greatest. On the other hand, if the snow falls late in the winter it

does not have time to become compact, but melts in the early spring and runs to waste long before the irrigators have the greatest necessity for it. It makes a great difference in the tenure of the water supply whether the snow falls at a time when the increased warmth of the sun causes a too rapid melting, and thereby uncontrollable torrents not available for agricultural purposes. The water supply attains its maximum height between June tenth and June twentieth.¹

That agriculture in Utah is dependent on artificial irrigation may be judged from the fact that the average annual rainfall in Utah is only 13.21 inches as compared with an average of 32 inches for the United States as a whole.

However, there are two exceptions to the general rule of artificial irrigation: (1) There are some localities naturally irrigated. (2) There are several localities in which the climate permits dry farming.

Along the low banks of many streams there are fertile strips of land. The soil is in every such case of a porous nature, and water from the stream percolates laterally and rises to the roots of the plant. Nearly all such lands are flooded in the springtime, and are usually devoted to hay as an exclusive crop. It rarely happens, however, that they are farmed without some irrigation, for the reason that the use of the convenient water renders the harvest more secure and abundant. The same fertility is sometimes induced by subterranean waters which have no connection with surface streams. In such cases there is always an impervious subsoil which retains percolating water near the surface. A remarkable instance of this sort is known at the western base of the Wasatch mountains. A strip of land from twenty to forty rods broad, and marking the junction of the mountain slope, has been found productive from Hampton's Budge to Brigham's City, a distance of eighteen miles. In some parts it has been irrigated, with the result of doubling or trebling the yield, but where water has not been ob-

¹ Report of the Utah Irrigation Commission, 1894.

tained the farmer has, nevertheless, succeeded in extracting a living. A similar but narrow belt of land lies at the eastern base of the Promontory range, and a few others have been found. In each locality the proximity of subterranean water to the surface is shown by the success of shallow wells.

There are at least two regions where natural irrigation is out of the question, but where crops have nevertheless been secured. Bear River City was founded by a company of Danes, who brought the water of the Malad river to irrigate their fields. After repeated experiments they became satisfied that the water was so brackish as to be injurious instead of beneficial, and they ceased to use it; and for a number of years they have obtained a meagre subsistence by dry farming. In some parts of Davis county, where the soil is sandy, "dry farming" is also profitable.

A phenomenon of physical geography, destined to have an important effect on irrigation in Utah, is the steady increase in the volume of its streams within the past twenty years. Of the actuality of this increase there can be little question, because the amount has been recorded in an independent and most thorough manner by the accumulation of water in the Great Salt Lake. It has been estimated that this increased water supply has made the lake 17 per cent larger to-day than it was in 1870. According to the reports of the Weather Bureau stationed at Salt Lake, there has been no increase in the annual rainfall; so the phenomenon is evidently not due to a climatic change.

Geologists hold that it is to be attributed to human agencies, that in proportion as the farmer ploughs the earth and makes it more porous and absorbent, a smaller percentage of the melted snow runs off. If this is true, not only is every gain of the present assured for the future, but a future gain may be predicted. For not only does the settler unconsciously enhance his natural privilege, but by the aid of a careful study of the subject he can devise such systematic methods as shall render his work still more effectual.

APPENDIX B.

SUB-IRRIGATION VERSUS SURFACE IRRIGATION.

It is held by some that irrigation water applied beneath the surface is better than surface irrigation, in relation to the amount used, the temperature of the soil, the amount of evaporation, washing of soil and yield of crop, including quality of crop received.

Mr. J. W. Sanborn, Director of the Utah Experiment Station, recently made a study of the relative merits of the two systems and arrived at substantially the following conclusions:¹

(1) Sub-irrigation, whether by large open drains or by the cement pipe system, fails to supply moisture enough for growing crops.

(2) The lateral movement of water is too slow to furnish the requisite supply for the evaporation of plants, being at the rate of a very few inches per day.

(3) The sub-irrigated soil is warmer than the surface irrigated soil.

(4) Lateral movement of water cannot be made rapid enough for maximum crop growth.

(5) Sub-irrigation is too costly for ordinary farm crops.

¹ Bulletin No. 26, Utah Agricultural College Experiment Station, 1893.

APPENDIX C.¹

SHOWING LENGTH OF THE IRRIGATION SEASON, NUMBER OF WATERINGS REQUIRED, ETC.

County.	Irrigation season begins.	Irrigation season ends.	Number of times lands irrigated during season.	Number of hours land is irrigated each time.	Elevation above sea in feet.	Depth of snow in adjacent mountains in feet.	Quantity of water per cubic foot per second.	Acres.
Beaver	.....May 15	August 15	8	24	5,000-6,000	4		
Box Elder	.....May	August	8	1½	4,000-5,000	3		
Cache	.....May	September	8	4	4,500	3		150
Davis	.....April	October	10	2½	4,200-5,000	3		
Emery	.....March	November			3,900-4,500	4		
Garfield	.....April	August	8	5	6,500	3		
Grand	.....April 15	October 1			5,800-6,300			80
Iron	.....April	November	6	6	5,000-6,000	4		
Juab	.....May	September	10		5,500	8		
Kane	.....April 1	October	8	12	5,500			75
Millard	.....April 15	August 15			5,500	3		
Morgan	.....May 20	September 1	7		4,000-5,000	6		100
Piute	.....April	September	5	8	5,000-7,000	4		
Rich	.....April	August	3	3	6,000	5		
Salt Lake	.....May 15	September 15	8		4,300	6		100
San Juan	.....				5,000			
San Pete	.....May 15	September	5	24	5,500	6		95
Sevier	.....April	October	5	1	4,000-7,000			
Summit	.....May	September	3		5,845	5		
Tooele	.....March	September			4,600	2		80
Uinta	.....April	October			4,600	6		
Utah	.....March	September	8		4,600	4		
Wasatch	.....				6,000-7,500	6		
Washington	.....April	October	12	3	2,700-5,000	4		40
Weber	.....May	October	12	2	4,500	2		

¹ Compiled from statistics furnished by Joseph P. Bache, State Statistician.

APPENDIX D.

INCORPORATED IRRIGATION COMPANIES OF UTAH.

Most of these companies are organized on the co-operative plan. They pay no dividends, having been formed for self-protection rather than profit. Each company has a board of directors and a water-master who is usually the only paid officer. The expenses of constructing, cleaning and repairing the canals are prorated according to the amount of stock each individual holds. The par value of the stock is much greater when city lots are irrigated than when ordinary farming land is irrigated. The unincorporated canals and ditches in Utah usually belong to cities. They are under the control of a water-master appointed by the City Council, and the acreage price of their lands is fixed by city ordinance. All landowners under the city canals have a right to the water by paying fifty cents per acre. The water is the property of the city and cannot be sold. The water-right is appurtenant to the land. A shareholder in an incorporated company, on the other hand, can sell his land and retain his water certificates. If the owner of the land does not hold the certificate, he must either rent or buy stock certificates. The price on the stock varies according to the volume of water supplied by the canal.

APPENDIX D.—Continued.

BEAVER COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Adamsville Land and Irrigation Co.....	June 28, 1892,	\$ 15,000	1,875	\$ 8 00	Adamsville.
Beaver Valley Land and Irrigation Co.....	May 23, 1894,	500,000	50,000	10 00	Salt Lake City.
Greenville Land and Irrigation Co.	Mar. 1, 1892,	6,000	300	20 00	Greenville.
Hooton Reservoir and Canal Co.	Dec. 21, 1895,	5,500	55	100 00	Beaver City.
Minersville Reservoir and Irrigation Co.....	Feb. 8, 1889,	30,000	2,000	15 00	Minersville.
North-East Bench Irrigation Co.	May 22, 1893,	10,000	1,000	10 00	Beaver City.
North-West Canal and Irrigation Co.	April 6, 1897,	6,850	685	10 00	Beaver City.
South Bench Reservoir and Irrigation Co.	Aug. 15, 1895,	5,000	5,000	1 00	Beaver City.
South Field Ditch Co.	May 1, 1895,	3,470	347	10 00	Beaver City.
West Field Canal and Irrigation Co.	Mar. 3, 1898,	6,890	689	10 00	Beaver City.

¹ Compiled from county records by W. Hurst, County Clerk.

BOX ELDER COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Bear River Irrigation and Ogden Waterworks Co..	Jan. 21, 1895,	\$2,400,000	24,000	\$100 00	Ogden.
Boise Valley Canal Co.....	Mar. 21, 1884,	200,000	2,000	100 00	Salt Lake City.
Idaho Irrigation and Colonization Co.....	July 30, 1887,	100,000	1,000	100 00	Salt Lake City.
Corinne Mill Canal and Stock Co.....	Jan. 1, 1883,	600,000	120,000	5 00	Corinne.
Marble Creek Irrigation Co.	July 1, 1893,	20,000	800	25 00	Brigham City.
Marble Land and Irrigation Co.....	Mar. 15, 1890,	500,000	.....	.....	Brigham City.

¹ Compiled from county records by George W. Watkins, County Clerk.

APPENDIX D.—Continued.

CACHE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Cache Valley Land and Canal Co.....	May 8, 1890,	\$1,000,000	10,000	\$100 00	Ogden.
Hyrum Irrigation Co.	Mar. 19, 1883,	20,000	4,000	5 00	Hyrum.
Logan, Hyde Park and Smithfield Canal Co.	Mar. 16, 1889,	20,000	4,000	5 00	Logan.
Logan and Smithfield Canal Co.	Dec. 18, 1880,	50,000	5,000	10 00	Logan.
Newton Irrigation Co.	Jan. 14, 1890,	10,000	10,000	1 00	Newton.
North-West Field Canal Co.	Apr. 28, 1890,	10,000	200	50 00	Logan.
Paradise Irrigation and Reservoir Co.	May 12, 1894,	7,000	.....	.....	Paradise.
Providence and Millville Canal Co.	Dec. 15, 1893,	21,000	3,500	6 00	Providence.
Wellsville Canal and Irrigating Co.	Mar. 16, 1888,	20,000	400	50 00	Wellsville.
Wellsville Handbrush Field and Manufacturing Co.	June 5, 1885,	1,650	165	10 00	Wellsville.
Wellsville East Field Irrigating Co.	Apr. 9, 1881,	3,267	653.5	5 00	Wellsville.
West Bear River Canal and Irrigating Co.	May 8, 1884,	1,000	200	5 00	Ogden.

Many of the largest canals of Cache county are unincorporated. Notable among these are the Logan, Hyde Park, and Thatcher Canal, irrigating 2115 acres; the Logan and Benson Ward Canal, irrigating 3006 acres, and the West Field, or Little Ditch, irrigating 1100 acres.

¹ Compiled from county records by H. J. Mathews, County Clerk.

CARBON COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Acreage Irrigated.	Place of Business.
Allred Ditch Co.	1883,	\$1,000	500	Castle Gate.
Hill Canal Co.	1894,	1,000	500	Castle Gate.
Pioneer Ditch Co.	1883,	2,000	1,500	Winter Quarters.
Price Water Co.	1881,	20,000	10,000	Price.
Price River Reservoir and Irrigation Co.	April 25, 1896,	1,000,000	.....	Salt Lake City.
Tidwell Ditch Co.	1883,	1,000	500	Wellington.
Tidwell Canal Co.	1887,	2,000	1,500	Wellington.
Wellington Canal Co.	1893,	3,000	2,000	Wellington.
Wilson Ditch Co.	1883,	1,000	500	Castle Gate.

¹ Compiled from county records by W. H. Donaldson, County Clerk.

APPENDIX D.—Continued.

DAVIS COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Adams Irrigation Co.	Jun. 20, 1892,	\$ 300	60	\$5 00	Bountiful City.
Bountiful Irrigation Co.	Feb. 26, 1884,	100,000	1,000	100 00	Bountiful City.
Bountiful Mill Creek Irrigation Co.	Apr. 3, 1896,	11,000	1,000	10 00	Bountiful City.
Holmes Creek Irrigation Co.	Feb. 8, 1897,	13,100	262	50 00	Farmington C.
Kays Creek Irrigation Co.	Apr. 17, 1897,	50,000	1,000	50 00	Kaysville City.
Kaysville Irrigation Co.	Mar. 9, 1898,	39,550	1,747	{ 141@ \$25.00 330@ \$12.50 }	Kaysville City.
North Callonwood Irrigation and Water Co.	Nov. 2, 1891,	30,000	300	100 00	Bountiful City.
Steed Creek Irrigation Co.	Jun. 24, 1895,	6,000	300	20 00	Steed.

¹ Compiled from county records by Nepht Palmer, Deputy Clerk.

EMERY COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Blue Cut Canal Co.	Jun. 2, 1890,	\$ 3,800	380	\$10 00	Castle Dale.
Cleveland Canal Co.	Oct. 20, 1889,	31,000	3,100	10 00	Cleveland.
Clipper Canal Co.	Jun. 2, 1890,	6,000	600	10 00	Orangeville.
Desert Lake Reservoir Co.	July 13, 1893,	50,000	5,000	10 00	Castle Dale.
Emery Canal and Reservoir Co.	Apr. 10, 1895,	10,000	1,000	10 00	Emery.
Ferron Creek Irrigation Co.	Mar. 30, 1896,	20,500	20,500	1 00	Ferron.
Great Western Co.	Feb. 20, 1896,	6,000	600	10 00	Castle Dale.
Huntington Canal and Agricultural Association..	May 25, 1889,	41,250	41,250	1 00	Huntington.
Independent Canal and Reservoir Co.	Dec. 28, 1894,	7,500	750	10 00	Independent.
Mammoth Canal Co.	May 23, 1893,	30,000	3,000	10 00	Mammoth.
Star Ditch	May 25, 1895,	915	183	5 00	Castle Dale.

¹ Compiled from county records by O. J. Slitetrud, County Clerk.

APPENDIX D.—Continued.

GARFIELD COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Acreage Irrigated.	Place of Business.
Cannonville Irrigation Co.....	July 6, 1889,	\$2,040	2,040	500	Cannonville.
Clifton Irrigation Co.....	June 2, 1891,	1,950	1,950	250	Panguitch.
East Panguitch Irrigation Co.....	.....	3,000	3,000	1,000	Panguitch.
Escalante Irrigation Co.....	July 19, 1890,	2,000	2,000	1,000	Escalante.
Henrieville Irrigation Co.....	Nov. 25, 1892,	1,000	.....	500	Henrieville.
Hillsdale Irrigation Co.....	June 14, 1897,	791	791	200	Hillsdale.
Long Canal Co.....	Feb. 10, 1888,	5,000	5,000	1,200	Escalante.
Tropic and East Fort Irrigation Co.....	Mar. 27, 1893,	3,000	3,000	1,000	Tropic.
West Panguitch Irrigation .....	.....	5,000	5,000	2,500	Panguitch.

¹ Compiled from county records by M. M. Stub, Jr., County Clerk.GRAND COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Place of Business.
Moab Irrigation Co.....	Moab.

¹ Compiled from county records by T. J. Elliott, County Clerk.

APPENDIX D.—Continued.

IRON COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Par Value Shares.	Place of Business.
Cedar City, North Union and Old West Field Reservoir and Irrigation Co.	May 10, 1892,	\$50,000	\$1 00	Cedar City.
Cedar City S. W. Field Reservoir and Irrigation Co.	March 3, 1892,	50,000	....	Cedar City.
Coal Creek Meadow and Cedar N. W. Field Irrigation Co.	March 3, 1890,	30,000	....	Cedar City.
Coal Creek Irrigation Co.	Feb. 27, 1888,	50,000	....	Cedar City.
Desert Reservoir and Irrigation Co.	May 20, 1890,	50,000	....	Parowan.
Old Fort and West Field Reservoir and Irrigation Co.	May 8, 1893,	30,000	20 00	Cedar City.
Parowan North Field Co.	March 23, 1893,	12,075	15 00	Parowan.
Red Creek Reservoir and Canal Co.	Dec. 12, 1892,	10,000	5 00	Paragoonah.

There are six other companies in Iron County, for which there is no record of incorporation. One of these is at Paragoonah, two at Parowan, one at Summit, and two at Cedar City.

¹Compiled from county records by Alfred M. Durham, County Clerk.

JUAB COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Levan Irrigation Co.	Apr. 18, 1884,	\$11,880	5,000	\$10 00	Levan.
Mona Irrigation Co.	July 8, 1896,	8,000	800	10 00	Mona.
Nephi Irrigation Co.	Dec. 13, 1883,	67,500	2,700	25 00	Nephi.
North Canyon Irrigation Co.	Feb. 18, 1893,	20,000	1,000	20 00	Nephi.
Wellington Irrigation Co.	Oct. 14, 1889,	25,000	2,500	10 00	Wellington.

¹Compiled from county records by Joel F. Grover, County Clerk.

APPENDIX D.—Continued.

KANE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Castle Creek Reservoir and Irrigation Co.	May 1, 1897,	\$1,350	1,350	\$1 00	Kanab.
Glendale Irrigation Co.	Mar. 2, 1885,	4,340	432	10 00	Glendale.
Kanab Irrigation Co.	Dec. 13, 1881,	50,000	5,000	10 00	Kanab.
Mt. Carmel Irrigation Co.	Feb. 28, 1896,	4,048	404	10 00	Mt. Carmel.
Orderville Irrigation Co.	Mar. 13, 1896,	2,980	298	10 00	Orderville.

¹ Compiled from county records by P. Spencer, County Clerk.MILLARD COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Place of Business.
Central Utah Land and Irrigation Co.	Feb. 3, 1890,	\$1,000,000	100,000	Clear Lake.
Clear Lake Land and Irrigation Co.	Nov. 30, 1892,	500,000	50,000	Clear Lake.
Cone Creek Irrigation Co.	Jan. 15, 1887,	19,692.50	1,690 $\frac{1}{4}$	Fillmore City.
Deseret Reservoir and Irrigation Co.	Mar. 6, 1885,	50,000	10,000	Deseret.
Fillmore Irrigation Co.	Jun. 14, 1886,	20,000	4,000	Fillmore City.
Gunnison Bend Canal Co.	Feb. 17, 1886,	25,000	1,000	Gunnison.
Holden Irrigation and Canal Co.	May 3, 1886,	1,500	1,500	Holden.
Leamington Irrigation Co.	Sep. 27, 1886,	15,000	1,500	Leamington.
Leamington Reservoir and Canal Co.	Apr. 16, 1896,	20,000	2,000	Leamington.
Meadow Irrigation Co.	Mar. 2, 1887,	7,128	297	Meadow.
Oak Creek Irrigation Ditch and Canal Co.	Feb. 1, 1887,	1,270	234	Oak City.
Oasis Canal Co.	May 15, 1893,	25,000	5,000	Oasis.
Oasis and Riverside Canal Co.	Feb. 13, 1886,	50,000	10,000	Oasis.
Scipio Irrigation Co.	Feb. 23, 1897,	75,000	6,000	Scipio.
Snake Valley Land and Water Co.	Feb. 20, 1890,	1,000,000	100,000	Salt Lake City.
Swan Lake Reservoir and Canal Co.	Mar. 3, 1890,	1,000,000	100,000	Salt Lake City.
White Mountain Reservoir and Canal Co.	May 3, 1895,	200,000	40,000	Fillmore City.

¹ Compiled from county records by J. S. Gilles, County Clerk.

APPENDIX D.—Continued.

MORGAN COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Croydon Irrigation Co.....	July 22, 1893,	\$5,000	1,000	\$5 00 } 10 00 }	Croydon.
Enterprise Bench Irrigation Co	April 19, 1889,	5,000	500	10 00 }	Canyon Creek.
Littleton and Milton Irrigation Co.....	June 4, 1888,	2,000	1,000	2 00	Milton.
Morgan City Mill Race Irrigation Co.....	Jan. 3, 1889,	2,000	400	5 00	Morgan City.
North Morgan City Irrigation Canal Co.....	Feb. 23, 1892,	2,000	200	10 00	Morgan City.
South Morgan Irrigation Co	Mar. 15, 1893,	2,500	....	5 00	Morgan City.
Weber Canal Co	Mar. 20, 1893,	....	....	5 00	Morgan City.

¹ Compiled from county records by D. A. Robison, County Clerk.

PIUTE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Beaver Creek Irrigation Co.....	Aug. 26, 1896,	\$5,625 50	450	\$12 50	Bullion.
Circleville Irrigation Co.....	June 7, 1897,	6,000 00	12,000	50	Circleville.
Junction Irrigation Co.....	Dec. 28, 1897,	5,500 00	5,500	1 00	Junction.
Kingston Irrigation Co.....	Feb. 3, 1896,	2,184 00	546	4 00	Kingston.
Koosharem Irrigation Co.....	June 29, 1889,	10,000 00	2,000	5 00	Koosharem.
Loss Creek Irrigation Co.....	Feb. 25, 1898,	1,500 00	1,500	1 00	Koosharem.

These irrigation canals and ditches irrigate 700, 2,427, 375, 300, 2,000, and 400 acres, respectively.

¹ Compiled from county records by William H. Luke, County Clerk.

RICH COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Laketown Canal Co.....	1887,	\$9,460 75	946	\$10 00	Laketown.
Laketown Irrigation Co.....	May 14, 1897,	8,382 50	838 1/4	10 00	Laketown.
Meadowville Canal Co.....	May 16, 1888,	5,000 00	1,000	5 00	Meadowville.
Meadowville Lower Canal Co	Apr. 26, 1889,	2,000 00	400	5 00	Meadowville.
Randolph and Woodruff Canal Co.....	Dec. 23, 1888,	14,000 00	1,900	10 00	Randolph.
Swan Creek Irrigation Canal Co.....	Jan. 15, 1894,	25,000 00	1,785 1/2	14 00	Woodruff.

¹ Compiled from county records by William Rex, County Clerk.

APPENDIX D.—Continued.

SALT LAKE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Alturas Land and Irrigation Co.	Apr. 9, 1890,	\$500,000	5,000	\$100 00	Salt Lake City.
Armstrong Land and Water Co.	Oct. 8, 1892,	500,000	5,000	100 00	Salt Lake City.
Beckstead Irrigation Co.	Nov. 27, 1888,	12,500	5,500	25 00	Salt Lake City.
Dry Creek Reservoir and Irrigation Co.	Apr. 25, 1891,	50,000	5,000	10 00	Salt Lake City.
East Jordan Irrigation Co.	Apr. 6, 1878,	200,000	8,000	25 00	East Jordan.
Herriman Irrigation Co.	Jan. 2, 1892,	11,550	231	50 00	Pt. Herriman.
Hydraulic Canal Co.	Dec. 27, 1889,	150,000	150,000	1 00	Salt Lake City.
Jordan and Salt Lake Surplus Water Co.	Mar. 9, 1885,	12,000	1,200	10 00	Salt Lake City.
Manning Valley Reservoir Co.	Mar. 17, 1894,	100,000	100,000	1 00	Salt Lake City.
North Jordan Irrigation Co.	Nov. 10, 1880,	100,000	4,000	25 00	North Jordan.
New State Irrigation Co.	Mar. 3, 1895,	1,000,000	1,000	100 00	Salt Lake City.
North Point Irrigation Co.	Mar. 19, 1886,	10,000	1,000	10 00	North Point.
North Point Consolidated Irrigation Co.	Aug. 15, 1889,	20,000	2,000	10 00	North Point.
Oquirrh Water and Land Co.	July 15, 1891,	400,000	400	100 00	Salt Lake City.
Payetta River Canal and Land Improvement Co. . .	Mar. 5, 1890,	100,000	10,000	10 00	Salt Lake City.
Price River Reservoir and Irrigation Co.	Dec. 2, 1895,	1,000,000	100,000	1 00	Salt Lake City.
Richards Irrigation Co.	Jan. 26, 1894,	12,500	500	25 00	Salt Lake City.
Sandy Irrigation Co.	Jan. 5, 1895,	16,550	662	25 00	Sandy.
Spring Creek Irrigation Co.	Oct. 5, 1892,	3,490	349	10 00	Salt Lake City.
South Jordan Canal Co.	Oct. 30, 1880,	150,000	600	25 00	South Jordan.
South Slide Water Co.	Oct. 22, 1892,	500,000	50,000	10 00	Salt Lake City.
Union and East Jordan Irrigation Co.	July 26, 1894,	15,000	1,500	10 00	Union.
Utah Water Co.	Apr. 24, 1890,	300,000	3,000	100 00	Salt Lake City.
West Point Canal Co.	Nov. 8, 1888,	10,000	1,000	10 00	West Point.

In addition to these irrigation companies, whose plants are located in Salt Lake County, some of the largest irrigation companies in the State whose plants are located in other counties, notably the Mt. Nebo Beet-Sugar and Land Co., the Lake Bonneville Water and Power Co., the Snake River Canal and Irrigation Co., the Swan Lake Reservoir Co., and the Fairview Reservoir and Irrigation Co., have their business headquarters in Salt Lake City.

¹ Compiled from county records by David C. Dunbar, County Clerk.

APPENDIX D.—Continued.

SAN JUAN COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Par Value Shares.	Acreage Irrigated.	Place of Business.
Blue Mountain Irrigation and Manufacturing Co.	Mar. 5, 1888,	\$15,000	\$5 00	1,500	Monticello.
White Mesa Canal Co.	Dec. 28, 1897,	100,000	1 00	5,000	Monticello.

At Bluff, on the San Juan river, there is a canal irrigating 250 acres of bottom land. The construction of this canal dates back to 1880. There are several unincorporated ditches in the northern end of the county irrigating approximately 1000 acres.

¹ Compiled from county records by A. L. F. MacDermott, County Clerk.

SEVIER COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Place of Business.
Annabella Irrigation Canal Co.	August 12, 1895,	\$7,726 33	Annabella.
Annabella Reservoir and Canal Co.	January 23, 1897,	10,000 00	Annabella.
Antelope Reservoir and Irrigation Co.	April 21, 1897,	5,500 00	Antelope.
Aurora Irrigation Co.	April 12, 1897,	5,600 00	Aurora.
Brooklyn Canal Co.	April 16, 1896,	25,000 00	Brooklyn.
Burville Irrigation Co.	November 24, 1893,	3,000 00	Burville.
Cedar Ridge Irrigation Co.	April 24, 1894,	10,000 00	Cedar Ridge.
Cottonwood and Red Butte Irrigation Co.	April 25, 1891,	300 00	Richfield.
Cove and Joseph Canal Co.	March 8, 1897,	15,000 00	Joseph.
Elsinore Canal Co.	March 19, 1895,	15,000 00	Elsinore.
Glenwood Irrigation Co.	January 31, 1891,	25,000 00	Glenwood.
Joseph Irrigation Canal Co.	July 20, 1895,	15,000 00	Joseph.
Loss Creek Irrigation Co.	July 1, 1893,	10,000 00	Richfield.
Monroe Irrigation Co.	February 11, 1896,	40,000 00	Monroe.
Monroe South Bend Canal Co.	March 11, 1892,	20,000 00	Monroe.
Otter Creek Reservoir Co.	August 16, 1897,	50,000 00	Richfield.
Redwood Irrigation Co.	May 3, 1890,	11,000 00	Redwood.
Richfield Irrigation Canal Co.	April 18, 1893,	30,000 00	Richfield.
Rocky Ford Canal Co.	March 4, 1890,	20,700 00	Richfield.
Vermillion Irrigation Co.	March 30, 1892,	10,000 00	Vermillion.
Vermillion Extension Canal and Irrigation Co.	May 30, 1892,	50,000 00	Vermillion.
Wells Irrigation Canal Co.	July 27, 1895,	7,000 00	Wells.
Willow Bend Irrigation Co.	April 1, 1891,	10,000 00	Salina.

¹ Compiled from county records by J. M. Lauritzen, Deputy County Clerk.

APPENDIX D.—Continued.

SUMMIT COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Hoytsville Irrigation Co., No. 1	April 15, 1884,	\$7,000	350	\$20 00	Hoytsville.
Kamas Irrigation Co.	June 3, 1890,	25,000	25,000	1 00	Kamas.
North Narrows Irrigation Co.	Feb. 21, 1891,	4,000	200	20 00	Coalville.
Peoa South Beach and Canal Co.	Mar. 24, 1887, {No. of shares subscribed }		782	5 00	Peoa.
South Kamas Irrigation Co.	Feb. 27, 1886,	4,000	160	25 00	Kamas.
Spring Creek Irrigation Co.	May 25, 1889,	900	300	3 00	Parley's Park.
Washington Irrigation Co.	Feb. 2, 1891,	10,000	1,000	10 00	Woodland.
West Hoytsville Irrigation Co.	Mar. 7, 1892,	2,223	171	13 00	Hoytsville.

¹ Compiled from county records by J. A. Smith, County Clerk.TOOELE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Gold Belt Water Co.	April 20, 1895,	\$150,000	15,000	\$10 00	Salt Lake City.
Grantsville North Willow Irrigation Co.	April 29, 1890,	10,000	.....	10 00	Grantsville.
Grantsville South Willow Irrigation Co.	Mar. 3, 1897,	22,400	2,800	8 00	Grantsville.
Tooele City Water Co.	April 14, 1890,	25,000	250	1 00	Tooele City.
Vernon Irrigation Co.	Mar. 9, 1892,	9,200	460	....	Vernon.
The Grantsville South Willow Company, at a cost of \$18,000, is piping its creek with 14 and 15-inch pipe in order to save loss of water through evaporation and leakage.					

¹ Compiled from county records by Arthur B. Bryan, County Clerk.UINTAH COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Acreage subject to irrigation.	Place of Business.
Ashley Central Irrigation Co.	Jan. 17, 1884,	\$8,000	320	6,400	Ashley.
Ashley Upper Irrigation Co.	Feb. 20, 1884,	28,000	1,120	11,200	Ashley.
Brush Creek Canal Co.	April 3, 1891,	16,000	1,600	2,500	Vernal.
Burns Beach Irrigation Co.	April 3, 1891,	12,000	302½	2,000	Vernal.
Lucern Valley Land and Water Co.	May 24, 1892,	50,000	5,000	.....	Salt Lake City.
Rock Point Irrigation Co.	Mar. 28, 1893,	1,200	120	.....	Ashley.

¹ Compiled from county records by Peter Hanson, County Clerk.

APPENDIX D.—Continued.

UTAH COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Alpine Irrigation Co.	May 12, 1880,	\$16,150	1,615	\$10 00	Alpine.
Alta Ditch and Canal Co.	May, 1893,	28,800	288	100 00	Alta.
Blue Cliff Canal Co.	Jun. 3, 1893,	50,000	2,000	25 00	Blue Cliff.
Cedar Fort Irrigation Co.	July 5, 1879,	13,920	56	.....	Cedar Fort.
Clinton Reservoir and Irrigation Co.	Aug. 31, 1896,	10,000	2,000	5 00	Clinton.
Enterprise Canal Co.	Feb. 8, 1876,	10,000	400	25 00	Enterprise.
Goshen Irrigation and Canal Co.	Apr. 18, 1877,	42,000	1,400	30 00	Goshen.
Goshen Warm Spring Irrigation and Canal Co.	Mar. 18, 1879,	5,120	320	16 00	Goshen.
Hard Serabble Canal Co.	Apr. 2, 1892,	1,410	141	10 00	Lehi.
Lake Bottom Canal Co.	Feb. 19, 1873,	14,500	290	50 00	Lake View.
Lehi Irrigation Co.	Apr. 17, 1880,	50,000	5,000	10 00	Lehi.
Lake Shore Irrigation Co.	Jun. 28, 1882,	7,000	.....	.....	Lake Shore.
Little Dry Creek Irrigation Co.	Mar. 25, 1892,	16,000	400	40 00	Lehi.
Mapleton Irrigation Co.	Jan. 20, 1889,	10,000	2,000	5 00	Mapleton.
Mt. Nebo Reservoir and Canal Co.	Dec. 3, 1892,	300,000	3,000	100 00	Salt Lake City.
Mt. Nebo Beet-Sugar and Land Co.	Jan. 17, 1893,	1,000,000	5,000	10 00	Salt Lake City.
North Bench Irrigation Co.	Jun. 14, 1880,	[Original Blank.]			Provo.
North Centre Ditch Co.	Jun. 14, 1880,	5,000	1,000	5 00	Provo.
North Union Irrigation Co.	Feb. 9, 1898,	50,120	1,008	47 75	Union.
Provo Bench Canal Co.	Mar. 26, 1872,	50,000	1,000	50 00	Provo.
Provo Bench Canal and Irrigation Co.	Feb. 26, 1887,	45,600	1,520	30 00	Provo.
Provo Water Works Co.	Jun. 30, 1890,	50,000	25,000	2 00	Provo.
Pleasant Grove Tunnel and Irrigation Co.	Aug. 1, 1890,	20,000	800	25 00	Pleasant Grove.
Rock Canyon Irrigation Co.	Apr. 21, 1881,	4,200	420	10 00	Payson.
Summit Creek Irrigation and Canal Co.	Mar. 23, 1876,	45,000	3,000	15 00	.....
Spanish Fork Irrigation and Mufg. Co.	Mar. 23, 1878,	21,000	1,400	15 00	Spanish Fork.
Salem Irrigation and Canal Co.	Mar. 23, 1878,	40,000	2,000	20 00	Salem.
Spring Creek Irrigation Co.	Jun. 14, 1880,	3,000	300	10 00	Spring Lake.
Spanish Fork South Irrigation Co.	Mar. 23, 1881,	40,000	3,333	12 00	Spanish Fork.
Spanish Fork West Irrigation Co.	May 14, 1881,	22,500	620	36 00	Spanish Fork.
Spanish Fork South-East Irrigation Co.	May 29, 1885,	15,000	1,500	10 00	Spanish Fork.
Spanish Fork West Field Irrigation Co.	Dec. 21, 1885,	35,000	7,000	5 00	Spanish Fork.

There are a number of private canals and ditches in Utah County which are not incorporated. Artesian wells, from 50 to 300 feet deep, are also much used for purposes of irrigation. Utah County has approximately 100,000 acres under irrigation ditches.

¹ Compiled from county records by George Havercamp, County Clerk.

APPENDIX D.—Continued.

UTAH COUNTY.—Continued.

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Starr Irrigation Co.	Sep. 30, 1892,	\$300,000	30,000	\$10 00	Provo.
Timpanogas Irrigation Co.	Feb. 3, 1878,	4,125	165	25 00	Provo.
Union Irrigation Co.	Feb. 11, 1882,	10,000	400	25 00	Union.
Union Irrigation and Canal Co.	Feb. 23, 1893,	7,483	299 $\frac{1}{4}$	25 00	Union.
Upper East Union Irrigation Co.	Feb. 16, 1884,	17,220	1,722	10 00	Union.
West Union Canal Co.	Mar. 13, 1897,	40,000	1,600	25 00	Union.

WASATCH COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Acreage Irrigated.	Place of Business.
Center Creek Irrigation Co.	Mar. 25, 1886,	\$5,000	500	600	Center.
Center Creek Water and Irrigation Co.	May 17, 1887,	5,000	500	500	Center.
Charleston Irrigation Co.	Feb. 25, 1888,	6,000	1,200	600	Charleston.
Daniels Creek Irrigation Co.	Apr. 22, 1887,	1,270	127	300	Midway.
Extension Irrigation Co.	Apr. 10, 1897,	5,000	5,000	....	Midway.
Hobbie Creek Irrigation Co.	May 13, 1896,	20,000	4,000	1,500	Heber City.
Lake Creek Irrigation Co.	Aug. 6, 1888,	20,000	2,000	500	Heber City.
Lake Creek Reservoir and Irrigation Co.	Feb. 29, 1888,	4,000	400	200	Heber City.
Main Creek Irrigation Co.	Nov. 10, 1887,	10,000	500	500	Heber City.
Midway and Charleston Irrigation Co.	Jan. 16, 1892,	1,000	200	200	Midway.
Midway Irrigation Co.	Mar. 2, 1888,	50,000	10,000	3,000	Midway.
Northfield Irrigation Co.	Feb. 12, 1890,	40,000	4,000	2,500	Heber City.
North Ditch Irrigation Co.	Dec. 30, 1887,	5,000	500	500	Heber City.
Sage Brush Irrigation Co.	Aug. 26, 1892,	5,000	5,000	250	Ruysville.
Spring Creek Ditch Irrigation Co.	Apr. 14, 1890,	3,456	3,456	1,200	Heber City.
Strawberry Canal Co.	Mar. 26, 1888,	3,665	365	365	Heber City.
Sunrise Irrigation Co.	July 15, 1895,	10,000	100	240	Heber City.
Timpanogas Irrigation Co.	May 25, 1895,	20,000	2,000	....	Heber City.
Wasatch Irrigation Co.	Jan. 11, 1896,	22,000	2,200	2,200	Heber City.
Wallsburgh Irrigation Co.	Dec. 30, 1887,	2,000	400	200	Wallsburgh.
Willow Creek Canal Co.	Feb. 17, 1892,	10,000	10,000	300	Heber City.

¹ Compiled from county records by John T. Giles, County Clerk.

APPENDIX D.—*Continued.*

WASHINGTON COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Par Value Shares.	Acreage Irrigated.	Place of Business.
Bloomington Irrigation Co.	May 4, 1891,	\$1,000	\$20 00	200	Bloomington.
Enterprise Reservoir and Canal Co.	Sep. 28, 1898,	40,000	10 00	350	St. George.
Hebron Canal Co.	Jan. 11, 1896,	10,000	10 00	200	Hebron.
Hurricane Canal Co.	Sep. 23, 1893,	80,000	40 00	{ Canal not } { completed }	Toquerville.
La Verkin Fruit and Nursery Co.	June 3, 1889,	25,000	10 00	120	St. George.
Price Irrigation Co.	May 14, 1891,	5,000	20 00	250	Virgin City.
Quail Creek Water Co.	Dec. 12, 1876,	60,000	1 00	400	Leeds.
Santa Clara Seepage and Ditch Co.	Jan. 11, 1896,	4,100	25 00	250	St. George.
Toquerville Irrigation Co.	Apr. 26, 1894,	15,000	50 00	300	Toquerville.
Washington Field Canal Co.	May 11, 1875,	60,000	12 00	2,500	Washington.

The Santa Clara Irrigation Co., an unincorporated company, irrigates 1,600 acres. The canal and reservoir of the Enterprise Reservoir and Canal Co. is not yet completed, and this accounts for the small acreage irrigated in proportion to the large capitalization. Washington County is especially adapted to the growing of fruit.

¹ Compiled from county records by Francis L. Doggett, County Clerk.

WAYNE COUNTY.¹

Name of Company.	Date Incorporation.	Shares.	Acreage subject to Irrigation.	Place of Business.
Fremont Irrigation Co.	June 17, 1889,	2,148	2,148	Fremont.
Grover Irrigation Co.	Mar. 6, 1893,	400	400	Grover.
North Ditch Irrigation Co.	Dec. 16, 1894,	890	890	Burgess.
Pleasant Creek Irrigation Co.	July 26, 1892,	256	256	Fremont.
Thurber Irrigation Co.	July 27, 1892,	231	231	Thurber.

¹ Compiled from county records by H. M. Hansen, County Clerk.

APPENDIX D.—Continued.

WEBER COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Shares.	Par Value.	Place of Business.
Adams and Kessel Salt Co.	Mar. 3, 1888,	\$100,000	1,000	\$100 00	Salt Lake City.
Davis and Weber Counties Canal Co.	Feb. 2, 1891,	200,000	4,000	500 00	Ogden.
Huntsville Irrigation Co.	Mar. 19, 1883,	5,000	5,000	1 00	Huntsville.
Huntsville Mountain Irrigation Co.	—, 1872,	5,000	5,000	1 00	Huntsville.
Last Chance Water Co.	Dec., 1884,	1,000	40	25 00	Ogden.
Liberty Irrigation Co.	Jan. 14, 1889,	10,080	1,008	10 00	Liberty.
Marriott Irrigation Co.	July 5, 1895,	29,300	586	50 00	Marriott.
North Ogden Irrigation Co.	May 3, 1875,	20,000	800	25 00	Ogden.
Pioneer Electric Power Co.	Nov. 27, 1893,	1,000,000	100,000	10 00	Ogden.
Pioneer Irrigation Canal Co.	Jan. 9, 1895,	5,000	100	50 00	Uintah.
Wilson Irrigation Co.	Jan. 4, 1896,	5,122	2,560%	2 00	Wilson.
Weber Canal Water Co.	July 2, 1892,	300,000	60,000	5 00	Ogden.

¹Compiled from county records by S. T. Myers, Deputy County Clerk.

UNINCORPORATED IRRIGATION COMPANIES IN WEBER COUNTY.

Name of Company.	Certificate Issued.	Date Appropriation.	Acresage subject to Irrigation.	Place of Business.
Eden Irrigation Co.	Feb. 26, 1881,	....	4,000	Eden.
Harrisville Irrigation Co. ....	....	1859	3,000	Harrisville.
Hooper City Irrigation Co.	Feb. 26, 1881,	....	6,500	Hooper City.
Hot Springs Canal Co.	Feb. 26, 1881,	....	4,500	Ogden.
Ogden Bench Canal Co.	Feb. 26, 1881,	1855	5,000	Ogden.
Plain City Irrigation Co.	Feb. 26, 1881,	....	6,500	Plain City.
Slaterville Canal Co.	Feb. 26, 1881,	....	1,000	Slaterville.
S. S. and M. Canal Co. ....	....	1861	2,000	Ogden.
Wilson Irrigation Co. No. 1	Feb. 26, 1881,	1861	2,500	Wilson.

NOTE.—Data as to incorporated irrigation companies of San Pete County could not be obtained.

APPENDIX D.—*Continued.*

SAN PETE COUNTY.¹

Name of Company.	Date Incorporation.	Capital Stock.	Place of Business.
Big Hill Reservoir Co.	February 27, 1886,	\$4,000	Spring City.
Moroni Irrigation Co.	March 10, 1887,	75,000	Moroni.
Gunnison Irrigation Co.	June 22, 1888,	50,000	Gunnison.
Sterling Irrigation Co.	August 14, 1888,	10,000	Sterling.
Oak Creek Irrigation Co.	February 18, 1889,	2,240	Fairview.
Birch Creek Irrigation Co.	March 11, 1889,	1,000	Fairview.
North Six-Mile Creek Irrigation Co.	April 1, 1889,	20,000	Sterling.
Wales Irrigation Co.	April 15, 1889,	2,740	Wales.
West Point Irrigation Co.	March 4, 1889,	7,660	Wales.
Manti Irrigation Co.	April 10, 1889,	100,000	Manti.
Gooseberry and Cottonwood Irrigation Co.	February 25, 1890,	20,000	Fairview.
Meadow Irrigating Co.	May 3, 1890,	500	Fairview.
Milburn Irrigation Co.	June 21, 1890,	1,250	Milburn.
Chester Sanpitch Canal Co.	April 16, 1891,	2,220	Chester.
Twin Creek Irrigation Co.	April 18, 1891,	19,000	Mt. Pleasant.
Pleasant Creek Irrigation Co.	April 18, 1891,	30,000	Mt. Pleasant.
Mayfield Irrigation Co.	March 9, 1892,	50,000	Mayfield.
Desert Irrigation Co.	May 10, 1892,	5,000	Wales.
Moroni and Mt. Pleasant Irrigating Ditch Co.	June 20, 1893,	30,000	Moroni.
Coal Fork Ditch Irrigation Co.	June 28, 1893,	1,400	Mt. Pleasant.

¹ Compiled from county records by Joel Shomaker, Irrigation Journalist and Correspondent, Manti, Utah.

APPENDIX D.—Continued.

SAN PETE COUNTY.—Continued.

Name of Company.	Date Incorporation.	Capital Stock.	Place of Business.
Spring City Irrigation Co.....	March 24, 1894,	\$3,000	Spring City.
Cottonwood Canal and Tunnel Co.....	November 9, 1894,	45,000	Ephraim.
West View Irrigation Co.....	June 17, 1895,	25,000	Gunnison.
Gunnison City and Antelope Valley Canal Co.....	February 18, 1896,	50,000	Gunnison.
Robbins and Kearnes Dam and Canal Co.....	February 25, 1896,	46,800	Gunnison.
Cedar Creek Reservoir Co.....	February 26, 1896,	15,000	Mt. Pleasant.
Mammoth Reservoir Co. ¹	March 4, 1896,	1,000,000	Manti.
Fayette Canal Co.	March 12, 1896,	2,340	Fayette.
Gunnison Highland Canal Co.....	March 14, 1896,	50,000	Gunnison.
Willow Creek Irrigation Co.....	April 17, 1897,	24,000	Axtell.
Sand Ridge Reservoir and Canal Co.....	December 22, 1897,	20,000	Ephraim.
Silver Creek and Sanpitch Reservoir Co.....	May 14, 1898,	7,000	Wales.

There are 31 incorporated irrigation companies in San Pete County, representing a capital stock of \$1,645,130. The total area irrigated is 34,286 acres; the total improved land, 60,010 acres; total unimproved land which can be irrigated, 40,970 acres.

¹ The Mammoth Reservoir Co. deserves to be placed in the table on page 70, as one of the largest irrigation corporations of the State.

INDEX.

A

Acre-foot, 60 and note.
 Acreage, of irrigated lands, 76,
 81; of irrigable lands, 106,
 182-185.
 Adams and Keisel Salt Co., 68-
 69.
 Agricultural College, 58, 90.
 Agriculture, of Utah, 54-55, 74-
 88.
 Alfalfa, in Utah, 85-86.
 Apples, in Utah, 92-93.
 Artesian wells, cost of, 73 note;
 in the Dakotas, 128.

B

Bank, the Kirtland, 25.
 Banks, co-operative, 99.
 Barter, 47-48, 47 note.
 Bear River Irrigation and Og-
 den Waterworks Co., 63-66,
 91.
 Bear River Valley, orchards in,
 65, 91.
 Beaver County, irrigation in, 78-
 80, 189; incorporated canal
 companies of, 191.
 Beaver Land and Irrigation
 Co., status of, 70; projected
 reservoir of, 180.
 Beet sugar, 26, 51, 67 note, 87.
 Beets, sugar, in Utah, 86-88.
 Big Cottonwood Canal Co., 30.
 Board of Control, State, 43
 note, 60, 160-168.
 Box Elder County, irrigation in,
 78-80, 189; incorporated canal
 companies of, 191.

C

Cache County, early canals in,
 18 note, 33; irrigation districts
 of, 40; irrigation in, 78-80,

189; incorporated canal com-
 panies of, 192.
 Cache Valley Land and Canal
 Co., status of, 70.
 California, District Law of, 38
 note, 141; State control in,
 129; co-operative exchanges
 in, 176-177.
 Canal companies, of Utah, 66-
 70, 190.
 Canals constructed, 52.
 Cannon, George Q., 19, 20, 69
 note.
 Cannon, *Senator*, bill introduced
 by, 106 note.
 Capitalistic irrigation, 63-73,
 157-158, 157 note; *vs.* the co-
 operative system, 71-73.
 Carbon County, irrigation in,
 78-80, 189; incorporated canal
 companies of, 192.
 Carey Act, 56-58; acceptance of,
 59-60, 68.
 Central Utah Land and Irriga-
 tion Co., status of, 70.
 Certainty, of irrigation crops,
 100, 108, 111.
 Cession, State, of irrigable
 lands, 56-58, 125-136; of
 swamp lands, 125-126, 133-
 135.
 Cherries, in Utah, 94.
 Church scrip, 98.
 Civil law, doctrine of water,
 146-149.
 Clear Lake Land and Irrigation
 Co., status of, 70; reservoir
 of, 181.
 Colorado, State control in, 129.
 Commission system, 91-92, 172-
 173.
 Common law, doctrine of water,
 148, 150-151.
 Co-operation, among the Mor-
 mons, 12-13 and note, 102-

- 103; commercial, 50-52;
among fruit-growers, 107, 173-177.
Co-operative banks, 99.
Co-operative beet sugar factory, 51, 87.
Co-operative Fruit Exchange, 107, 173-177.
Co-operative system of irrigation, formation of, 7-12; distinctive features of, 12-21; development under, 22-34, 36-41, 102-103, 141-152; *vs.* capitalistic irrigation, 71-73.
Corporations, irrigation, 66-70, 190.
Crops, statistics of, 82-83.

D

- Davis and Weber Counties Canal Co., status of, 70; reservoir of, 180.
Davis County, irrigation in, 78-79, 189; incorporated canal companies of, 193.
Deseret, name, 29 and note.
Desert Land Act, 55-57, 117-118.
District law, of California, 38 note, 141.
District law, of Utah, 36-41, 36 note, 38 note, 40 note, 141-142.
District Court canal system, 166-167.
District system, of irrigation, 36-41, 141-152.
Diversified production, 18-19, 98, 108.
Dry farming *vs.* irrigation, 83; where possible, 187.
Duty, of water, 10 note.

E

- Eden Canal, 33.
Emery County, irrigation in, 78-80, 189; incorporated canal companies of, 193.
Enabling Act, 58.

F

- Farm statistics, of Utah, 75.
Farm unit, small, 18, 76, 99, 108-109, 112.

- Fertilizers, use of, 18 and note, 80.
Financial results, of irrigation, 100-103.
Forests, of Utah, 132-133.
Fruit exchange, co-operative, 173-177.
Fruits, of Utah, 89-95; yield and prices, 94-95.

G

- Garden produce, in Utah, 88.
Garfield County, irrigation in, 78-80, 189; incorporated canal companies of, 194.
Geological Survey, reservoir sites selected by, 181.
Gold fever, effects of, on Utah, 8 notes, 26-27.
Government, general, reclamation by, 118-125; advantages of, 118-121; objections to, 121-125.
Grand County, irrigation in, 78-80, 189; incorporated canal companies of, 194.
Grapes, in Utah, 94.
Grazing industry, in Utah, 97-98, 130-132.
Gunnison reservoir, 180.

H

- Hebron reservoir, 181.
Home market, importance of, 19, 96.
Homestead law, 35-36 and note, 55, 116-117.
Horticultural Commission, 90.
Horticulture, in Utah, 65, 89-95.

I

- Indebtedness, statistics of, 78.
Indian reservations, opening of, to settlement, 106 and note.
Intensive cultivation, 18 and note, 112.
Iron County, irrigation in, 78-80, 189; incorporated canal companies of, 195.
Irrigable lands, in Utah, 106, 182-185.
Irrigation, in foreign countries, 1-3, 119-120, 146-147, 160.

Irrigation, in Utah, vii-xv, 1-205; importance of study, vii; materials, vii-viii, xiii-xv; economic history of, 1-103; introduction, 1-6; co-operative system of, 7-41; formation, 7-12; distinctive features, 12-21; development under, 22-34, 102-103; legislation affecting, 35-41, 55-62; district system, 36-41, 141-152; priority of rights, 41-44, 160-165; transportation and commerce, 45-54, 96-99; plant, value of, 53-54; capitalistic system of, 63-73, 157-158, 157 note; irrigation corporations, 70, 190-205; capitalistic *vs.* co-operative, 71-73; agriculture and, 74-88; statistics of, 75-81, 189; dry farming *vs.*, 83; horticulture and, 89-95; financial results of, 100-103; problems of, 105-189; State control of, 160-168; need of measuring water, 169-171; produce, means of marketing, 172-177; water supply, 178-181; natural, 186-187; surface, *vs.* sub-irrigation, 188; season, 189. *See* Reclamation and Contents, ix-xi.

Irrigator, profit to, 53-54, 71-72.

J

Jordan Irrigation Co., 34.

Juab County, irrigation in, 78-80, 189; incorporated canal companies of, 195.

K

Kane County, irrigation in, 78-80, 189; incorporated canal companies of, 196.

Kirtland bank, 25; notes of, 48.

L

Lake Bonneville Water and Power Co., 67-68, 70, 179.

Lands, arid, State cession of, 56-58, 125-136; reclamation of, 105-159; advantages of, 108-115; methods of, 116-136; ad-

ministrative systems of, 137-159.

Lands, irrigated, acreage of, 76; irrigable, acreage of, 106, 182-185.

Lands, public, methods of acquiring, 55 note.

Lands, swamp, State cession of, 125-126, 133-135.

Lehi, beet sugar factory at, 51, 87.

Logan and Richmond Canal, 18 note.

Logan, Hyde Park and Smithfield Canal, 18 note.

Logan, Hyde Park and Thatcher Canal, 33.

M

Mammoth Co., reservoir of, 180-181.

Marketing, irrigation produce, 172-177.

Marysville Reservoir Co., status of, 70; reservoir of, 181.

Measuring, water used for irrigation, 107, 169-171.

Millard County, irrigation in, 78-80, 189; incorporated canal companies of, 196.

Mining, in Utah, 27, 48-49, 48 note.

Money, introduction of, 9, 24-25; substitutes for, 47-48, 47 note.

Morgan County, irrigation in, 78-80, 189; incorporated canal companies of, 197.

Mormons, the, emigration of, 1, 3-6, 4 note; early difficulties, 7-9; initial methods of irrigation, 9-13; co-operation among, 12-13 and note, 102-103; economic system of, 14-20; progress of, 20-34, land titles of, 35 note; success of, 100-103.

Mt. Nebo Beet Sugar and Land Co., 67 note, 70.

Mt. Nebo Land and Irrigation Co., 66-67 and note, 91, 179.

Municipal ownership of canals, 18 and note.

N

Natural irrigation, in Utah, 186-187.

O

Oats, in Utah, 85.
Ogden Bench Canal Co., 30.
Orchards, in Bear River Valley, 65, 91.

P

Pauperism, remedy for, 112-115.
Peaches, in Utah, 93.
Pears, in Utah, 93.
Pioneer Electric Power Co., 69, 70; reservoir of, 180.
Piute County, irrigation in, 78-80, 189; incorporated canal companies of, 197.
Plain City Canal, 33.
Plant, irrigation, value of, 53-54.
Potatoes, in Utah, 86.
Price River Reservoir and Irrigation Co., status of, 70.
Priority of rights, system of, 17, 41-44, 129, 148, 150-151; abuses of, 160-165, 162 note.
Private enterprise, irrigation by means of, 59-60, 63-73; advantages of, 152-158; apparent objection to, 158.
Produce, irrigation, means of marketing, 172-177.
Profits, to irrigator, 53-54, 71-72.
Public corporations, irrigation by, 36-41; advantages of, 141-148; objections to, 148-152.
Public land, methods of acquiring, 55 note.

R

Railroads, secured, 45-47; effects of, 47-49, 96-97.
Reclamation, of arid lands, 105-159; problems of, 105-107; advantages of, 108-115; under present laws, 116-118; by the General Government, 118-125; State cession in trust, 125-136; by the State, 137-141; by public corporations, 141-152;

by private enterprise, 152-158; resumé, 159.
Reservations, Indian, opening of, to settlement, 106 and note.
Reservoirs, storage, 66-67, 179-181.
Rich County, irrigation in, 78-80, 189; incorporated canal companies of, 197.

S

Salt Lake County, irrigation districts of, 40; irrigation in, 78-80, 189; incorporated canal companies of, 198.
San Juan County, irrigation in, 78-80, 189; incorporated canal companies of, 199.
San Pete County, irrigation in, 78-80, 189; incorporated canal companies of, 205.
Scrip, church, 98.
Season, irrigation, 189.
Second-foot, 60.
Seepage, 11 note, 118.
Sevier County, irrigation in, 78-80, 189; incorporated canal companies of, 199.
Slaterville Canal, 33.
Snake Valley Land and Water Co., status of, 70; reservoir of, 180.
Snowfall, 185-186.
Sorghum, in Utah, 88.
Specialization, due to irrigation, 109.
Speculation, opposition to, 23-24.
State, reclamation of arid lands by the, 137-141; advantages of, 137-138; objections, 138-141.
State Board of Control, 43 note, 60, 107, 160-168.
State cession, of arid lands, 56-58, 125-136; advantages of, 125-133; objections to, 133-136; of swamp lands, 125-126, 133-135.
State Engineer, 61-62.
Statistics, of lands ceded to Utah, 58; irrigation corporations, 70, 190-205; capitalistic vs. co-operative irrigation, 71-

72; general farms, 75; irrigation, 76-81, 189; crops, 82-84; irrigation *vs.* dry farming, 83; garden produce, 88; fruits, 90, 94-95; wealth of Utah, 101-102; irrigable lands, 106, 182-185.
 Storage reservoirs, 66-67, 118, 128, 179-181.
 Streams, increased volume of, 187.
 Sub-irrigation *vs.* surface irrigation, 188.
 Sugar, beet, 26, 51, 67 note, 87.
 Sugar beet, in Utah, 86-88.
 Sugar cane, sorghum, in Utah, 88.
 Summit County, irrigation in, 78-80, 189; incorporated canal companies of, 200.
 Supervision, State, 130.
 Surface irrigation *vs.* sub-irrigation, 185, 188.
 Surveys, governmental, 124, 181.
 Swamp lands, State cession of, 125-126, 133-135.
 Swan Lake Reservoir and Canal Co., status of, 70; reservoir of, 179-180.

T

Tables. *See* Statistics.
 Taxation, and irrigation, 115.
 Taylor Irrigation Co., reservoirs of, 181.
 Titling, 14 note.
 Tooele County, irrigation in, 78-80, 189; incorporated canal companies of, 200.

U

Uintah County, irrigation in, 78-80, 189; incorporated canal companies of, 200.
 University of Utah, 28, 58.
 Urban population, increasing, 112-113.
 Utah, irrigation in, 1-205. *See* Irrigation.
 Utah, settlement of, 3-21; legislation affecting, 35-44, 55-62; transportation and commerce of, 45-54, 96-99; canal companies of, 70, 190-205; agricul-

ture of, 74-88; horticulture of, 89-95; irrigable lands of, 106, 182-185; water supply of, 178-179.
 Utah Central Railroad, 46 and note.
 Utah County, early canals in, 18 note; irrigation districts of, 40; irrigation in, 78-80, 189; incorporated canal companies of, 201, 202.
 Utah war, 32 and note.

V

Village community, 14-16.

W

Wasatch County, irrigation in, 78-80, 189; incorporated canal companies of, 202.
 Washington County, irrigation in, 78-80, 189; incorporated canal companies of, 203.
 Water right, 12, 128-129; monopoly of, 23-24; distribution of, 36-44; right, cost of, 52-53, 71-72, 77; appropriation of, 60; public character of, 109-110; diversion of, 130; civil law doctrine of, 146-149; common law doctrine of, 148, 150-151; State control of, 160-168; wasted, 163; measurement of, 169-171; supply of, 178-179.
 Waterings, number of, 189.
 Watermaster, 17-18.
 Wayne County, irrigation in, 78-80, 189; incorporated canal companies of, 203.
 Weber County, early canals in, 18 note, 33; irrigation district of, 40; irrigation in, 78-80, 189; incorporated canal companies of, 204; unincorporated canal companies of, 204.
 Wheat, in Utah, 84-85.
 Woodruff, Wilford, 8, 19.
 Wright District Law, of California, 88 note, 141.
 Wyoming, State control in, 129, 160, 168.

Y

Yields, average, of crops, 83;
of garden produce, 88; of
fruits, 90, 94.

Young, Brigham, exodus under,
3-4; on mines, 8 note, 27; fa-
vors small farms, 18 note; fa-
vors the home market, 19; on

irrigation, 23; on speculation,
23; in favor of railroads and
mines, 50.

Z

Zion Co-operative Mercantile
Institution, 50-51.

JOHNS HOPKINS UNIVERSITY STUDIES

IN

Historical and Political Science.

HERBERT B. ADAMS, Editor.

FIRST SERIES.—Local Institutions.—1883.—\$4.00.

- I. **An Introduction to American Institutional History.** By EDWARD A. FREEMAN. 25 cents.
- II. **The Germanic Origin of New England Towns.** By H. B. ADAMS. 50 cents.
- III. **Local Government in Illinois.** By ALBERT SHAW.—**Local Government in Pennsylvania.** By E. R. L. GOULD. 30 cents.
- IV. **Saxon Tithingmen in America.** By H. B. ADAMS. 50 cents.
- V. **Local Government in Michigan, and the Northwest.** By E. W. BEMIS. 25 cents.
- VI. **Parish Institutions of Maryland.** By EDWARD INGLE. 40 cents.
- VII. **Old Maryland Manors.** By JOHN HEMSLEY JOHNSON. 30 cents.
- VIII. **Norman Constables in America.** By H. B. ADAMS. 50 cents.
- IX-X. **Village Communities of Cape Ann and Salem.** By H. B. ADAMS. 50 cents.
- XI. **The Genesis of a New England State.** By A. JOHNSTON. 30 cents.
- XII. **Local Government and Free Schools in South Carolina.** By B. J. RAMAGE. 40 cents.

SECOND SERIES.—Institutions and Economics.—1884.—\$4.00:

- I-II. **Methods of Historical Study.** By H. B. ADAMS. 50 cents.
- III. **The Past and the Present of Political Economy.** By R. T. ELY. 35 cents.
- IV. **Samuel Adams, The Man of the Town Meeting.** By JAMES K. HOSMER. 35 cents.
- V-VI. **Taxation in the United States.** By HENRY CARTER ADAMS. 50 cents.
- VII. **Institutional Beginnings in a Western State.** By JESSE MACY. 25 cents.
- VIII-IX. **Indian Money as a Factor in New England Civilization.** By WILLIAM B. WEEDEN. 50 cents.
- X. **Town and County Government in the English Colonies of North America.** By EDWARD CHANNING. 50 cents.
- XI. **Rudimentary Society among Boys.** By J. HEMSLEY JOHNSON. 50 cents.
- XII. **Land Laws of Mining Districts.** By C. H. SHINN. 50 cents.

THIRD SERIES.—Maryland, Virginia and Washington.—1885.—\$4.00.

- I. **Maryland's Influence upon Land Cessions to the United States.** By H. B. ADAMS. 75 cents.
- II-III. **Virginia Local Institutions.** By E. INGLE. 75 cents.
- IV. **Recent American Socialism.** By RICHARD T. ELY. 50 cents.
- V-VI-VII. **Maryland Local Institutions.** By LEWIS W. WILHELM. \$1.00.
- VIII. **The Influence of the Proprietors in Founding the State of New Jersey.** By AUSTIN SCOTT. 25 cents.
- IX-X. **American Constitutions; The Relations of the Three Departments as Adjusted by a Century.** By HORACE DAVIS. 50 cents.
- XI-XII. **The City of Washington.** By J. A. PORTER. 50 cents.

FOURTH SERIES—Municipal Government and Land Tenure.—1886.—\$3.50.

- I. **Dutch Village Communities on the Hudson River.** By I. ELTING. 50 cents.
- II-III. **Town Government in Rhode Island.** By W. E. FOSTER.—**The Narragansett Planters.** By EDWARD CHANNING. 50 cents.
- IV. **Pennsylvania Boroughs.** By WILLIAM P. HOLCOMB. 50 cents.
- V. **Introduction to the Constitutional and Political History of the Individual States.** By J. F. JAMESON. 50 cents.
- VI. **The Puritan Colony at Annapolis, Maryland.** By D. R. RANDALL. 50 cents.
- VII-VIII-IX. **History of the Land Question in the United States.** By S. SATO. \$1.00.
- X. **The Town and City Government of New Haven.** By C. H. LEVERMORE. 50 cents.
- XI-XII. **The Land System of the New England Colonies.** By M. EGGLESTON. 50 cents.

FIFTH SERIES.—Municipal Government, History and Politics.—1887.—\$3.50.

- I-II.** City Government of Philadelphia. By E. P. ALLINSON and B. PENROSE. 50 cents.
III. City Government of Boston. By JAMES M. BUGBEE. 25 cents.
IV. City Government of St. Louis. By MARSHALL S. SNOW. 25 cents.
V-VI. Local Government in Canada. By JOHN GEORGE BOURINOT. 50 cents.
VII. The Influence of the War of 1812 upon the Consolidation of the American Union. By NICHOLAS MURRAY BUTLER. 25 cents.
VIII. Notes on the Literature of Charities. By HERBERT B. ADAMS. 25 cents.
IX. The Predictions of Hamilton and De Tocqueville. By JAMES BRYCE. 25 cents.
X. The Study of History in England and Scotland. By P. FRÉDÉRIQ. 25 cents.
XI. Seminary Libraries and University Extension. By H. B. ADAMS. 25 cents.
XII. European Schools of History and Politics. By A. D. WHITE. 25 cents.

SIXTH SERIES.—The History of Co-operation in the United States.—1888.—\$3.50.

SEVENTH SERIES.—Social Science, Education and Government.—1889.—\$3.50.

- I.** Arnold Toynbee. By F. C. MONTAGUE. With an Account of the Work of Toynbee Hall in East London, by PHILIP LYTTTELTON GELL. 50 cents.
II-III. The Establishment of Municipal Government in San Francisco. By BERNARD MOSES. 50 cents.
IV. The City Government of New Orleans. By WM. W. HOWE. 25 cents.
V-VI. English Culture in Virginia. By WILLIAM P. TRENT. \$1.00.
VII-VIII-IX. The River Towns of Connecticut. By CHARLES M. ANDREWS. \$1.00.
X-XI-XII. Federal Government in Canada. By JOHN G. BOURINOT. \$1.00.

EIGHTH SERIES.—History, Politics and Education.—1890.—\$3.50.

- I-II.** The Beginnings of American Nationality. By A. W. SMALL. \$1.00.
III. Local Government in Wisconsin. By D. E. SPENCER. 25 cents.
IV. Spanish Colonization in the Southwest. By F. W. BLACKMAR. 50 cents.
V-VI. The Study of History in Germany and France. By P. FRÉDÉRIQ. \$1.00.
VII-VIII-IX. Progress of the Colored People of Maryland since the War. By JEFFREY R. BRACKETT. \$1.00.
X. The Study of History in Belgium and Holland. By P. FRÉDÉRIQ. 50 cents.
XI-XII. Seminary Notes on Recent Historical Literature. By H. B. ADAMS, J. M. VINCENT, W. B. SCAIFE, and others. 50 cents.

NINTH SERIES.—Education, History, Politics, and Social Science.—1891.—\$3.50.

- I-II.** Government and Administration of the United States. By W. W. WILLOUGHBY and W. F. WILLOUGHBY. 75 cents.
III-IV. University Education in Maryland. By B. C. STEINER. The Johns Hopkins University (1876-1891). By D. C. GILMAN. 50 cents.
V-VI. Development of Municipal Unity in the Lombard Communes. By WILLIAM K. WILLIAMS. 50 cents.
VII-VIII. Public Lands and Agrarian Laws of the Roman Republic. By ANDREW STEPHENSON. 75 cents.
IX. Constitutional Development of Japan (1853-1881). By TOYOKICHI IYENAGA. 50 cents.
X. A History of Liberia. By J. H. T. MCPHERSON. 50 cents.
XI-XII. The Character and Influence of the Indian Trade in Wisconsin. By FREDERICK JACKSON TURNER. 50 cents.

TENTH SERIES.—Church and State: Columbus and America.—1892.—\$3.50.

- I.** The Bishop Hill Colony. By MICHAEL A. MIKKELSEN. 50 cents.
II-III. Church and State in New England. By PAUL E. LAUER. 50 cents.
IV. Church and State in Maryland. By GEORGE PETRIE. 50 cents.
V-VI. The Religious Development in the Province of North Carolina. By STEPHEN B. WEEKS. 50 cents.
VII. Maryland's Attitude in the Struggle for Canada. By JOHN W. BLACK. 50 cents.
VIII-IX. The Quakers in Pennsylvania. By A. C. APPLEGARTH. 75 cents.
X-XI. Columbus and his Discovery of America. By H. B. ADAMS and H. WOOD. 50 cents.
XII. Causes of the American Revolution. By J. A. WOODBURN. 50 cents.

ELEVENTH SERIES.—Labor, Slavery, and Self-Government.—1893.—\$3.50.

- I.** The Social Condition of Labor. By E. R. L. GOULD. 50 cents.
II. The World's Representative Assemblies of To-Day. By E. K. ALDEN. 50 cents.
III-IV. The Negro in the District of Columbia. By EDWARD INGLE. \$1.00.
V-VI. Church and State in North Carolina. By STEPHEN B. WEEKS. 50 cents.
VII-VIII. The Condition of the Western Farmer. By A. F. BENTLEY. \$1.00.
IX-X. History of Slavery in Connecticut. By BERNARD C. STEINER. 75 cents.
XI-XII. Local Government in the South and Southwest. By E. W. BEMIS. \$1.00.

TWELFTH SERIES.—Institutional and Economic History.—1894.—\$3.50.

- I-II.** The Cincinnati Southern Railway. By J. H. HOLLANDER. \$1.00.
III. The Constitutional Beginnings of North Carolina. By J. S. BASSETT. 50 cents.
IV. The Struggle for Religious Toleration in Va. By H. R. MCILWAINE. 50 cents.
V-VI-VII. The Carolina Pirates and Colonial Commerce. By S. C. HUGHSON. \$1.00.
VIII-IX. History of Representation and Suffrage in Mass. By G. H. HAYNES. 50 cents.
X. English Institutions and the American Indian. By J. A. JAMES. 25 cents.
XI-XII. The Beginnings of the Congo Free State. By J. S. REEVES. 50 cents.

**THIRTEENTH SERIES.—South Carolina, Maryland,
and Virginia.—1895.—\$3.50.**

- I-II.** Government of the Colony of South Carolina. By EDSON L. WHITNEY. 75 cents.
III-IV. Early Relations between Maryland and Virginia. By J. H. LATANÉ. 50 cents.
V. The Rise of the Bicameral System in America. By THOMAS F. MORAN. 50 cents.
VI-VII. White Servitude in the Colony of Virginia. By JAMES C. BALLAGH. 50 cents.
VIII. The Genesis of California's First Constitution. By R. D. HUNT. 50 cents.
IX. Benjamin Franklin as an Economist. By W. A. WETZEL. 50 cents.
X. The Provisional Government of Maryland (1774-1777). By J. A. SILVER. 50 cents.
XI-XII. Government and Religion of the Va. Indians. By S. R. HENDREN. 50 cents.

**FOURTEENTH SERIES.—Baltimore, Slavery and Constitutional
History.—1896.—\$3.50.**

- I.** Constitutional History of Hawaii. By HENRY E. CHAMBERS. 25 cents.
II. City Government of Baltimore. By THADDEUS P. THOMAS. 25 cents.
III. Colonial Origins of New England Senates. By F. L. RILEY. 50 cents.
IV-V. Slavery and Servitude in the Colony of N. C. By J. S. BASSETT. 50 cents.
VI-VII. Representation in Virginia. By J. A. C. CHANDLER. 50 cents.
VIII. History of Taxation in Connecticut (1636-1776). By F. R. JONES. 50 cents.
IX-X. A Study of Slavery in New Jersey. By HENRY S. COOLEY. 50 cents.
XI-XII. Causes of the Maryland Revolution of 1689. By F. E. SPARKS. 50 cents.

**FIFTEENTH SERIES.—American Economic History.—1897.—
Subscription, \$3.00.**

- I-II.** The Tobacco Industry in Virginia since 1860. By B. W. ARNOLD. 50 cents.
III-IV-V. The Street Railway System of Philadelphia. By F. W. SPEIRS. Paper, 75 cents. Cloth, \$1.00.
VI. Daniel Raymond: An Early Chapter in the History of Economic Theory in the United States. By C. P. NEILL. 50 cents.
VII-VIII. The Economic History of the Baltimore and Ohio Railroad (1827-53). By MILTON REIZENSTEIN. 50 cents.
IX. The South American Trade of Baltimore. By F. R. RUTTER. 50 cents.
X-XI. State Tax Commissions in the United States. By J. W. CHAPMAN, JR. 50 cents.
XII. Tendencies in American Economic Thought. By SIDNEY SHERWOOD. 25 cents.

SIXTEENTH SERIES.—In Progress.—Subscription, \$3.00.

- I-IV.** Neutrality of the American Lakes and Anglo-American Relations. By J. M. CALLAHAN. \$1.50.
V. West Florida in its Relation to the Historical Cartography of the United States. By H. E. CHAMBERS. 25 cents.
VI. Anti-Slavery Leaders of North Carolina. By J. S. BASSETT.
VII. Life and Administration of Sir Robert Eden. By B. C. STEINER.
VIII. The Transition of North Carolina from a Colony to a Commonwealth. By E. W. SIKES.
IX. History of State Banking in Maryland. By A. C. BRYAN.
X. Maryland and Virginia Boundary Controversy. By L. N. WHEALTON.
XI. Labadist Colony in Maryland. By B. B. JAMES.
XII. Early Development of Chesapeake & Ohio Canal Project. By G. W. WARD.

Other papers will be from time to time announced.

THE JOHNS HOPKINS PRESS,
BALTIMORE, MD.

Extra Volumes of Studies

—IN—

HISTORICAL AND POLITICAL SCIENCE.

-
- The Republic of New Haven.** By CHARLES H. LEVERMORE, Ph. D. 342 pages. 8vo. Cloth. \$2.00.
- Philadelphia, 1681-1887.** By EDWARD P. ALLINSON, A. M., and BOIES PENROSE, A. B. 444 pages. 8vo. Cloth. \$3.00.
- Baltimore and the Nineteenth of April, 1861.** By GEORGE WILLIAM BROWN, Chief Judge of the Supreme Bench of Baltimore, and Mayor of the City in 1861. 176 pages. 8vo. Cloth. \$1.00.
- Local Constitutional History of the United States.** By GEORGE E. HOWARD, Ph. D. Volume I.—Development of the Township, Hundred and Shire. 542 pages. 8vo. Cloth. \$3.00. Volume II.—In preparation.
- The Negro in Maryland.** By JEFFREY R. BRACKETT, Ph. D. 270 pages. 8vo. Cloth. \$2.00.
- The Supreme Court of the United States.** By W. W. WILLOUGHBY, Ph. D. 124 pages. 8vo. Cloth. \$1.25.
- The Intercourse between the U. S. and Japan.** By INAZO (OTA) NITOBE, Ph. D. 198 pages. 8vo. Cloth. \$1.25.
- State and Federal Government in Switzerland.** By JOHN MARTIN VINCENT, Ph. D. 225 pages. 8vo. Cloth. \$1.50.
- Spanish Institutions of the Southwest.** By FRANK W. BLACKMAR, Ph. D. 380 pages. 8vo. Cloth. \$2.00.
- An Introduction to the Study of the Constitution.** By MORRIS M. COHN. 250 pages. 8vo. Cloth. \$1.50.
- The Old English Manor.** By C. M. ANDREWS, Ph. D. 280 pages. 8vo. Cloth. \$1.50.
- America: Its Geographical History, 1492-1892.** By WALTER B. SCAIFE, Ph. D. 176 pages. 8vo. Cloth. \$1.50.
- Florentine Life during the Renaissance.** By WALTER B. SCAIFE, Ph. D. 256 pages. 8vo. Cloth. \$1.50.
- The Southern Quakers and Slavery.** By STEPHEN B. WEEKS. 400 pages. 8vo. Cloth. \$2.00.
- Contemporary American Opinion of the French Revolution.** By C. D. HAZEN. 325 pages. 8vo. Cloth. \$2.00.
- Industrial Experiments in the British Colonies of North America.** By ELEANOR L. LORD. 164 pages, 8vo. Cloth, \$1.25.
-

The extra volumes are sold at reduced rates to regular subscribers to the "Studies."

The set of fifteen (regular) series is now offered, uniformly bound in cloth, for library use, for \$45, and including subscription to the current (sixteenth) series, for \$48.00.

The fifteen series, with sixteen extra volumes, altogether thirty volumes, in cloth as above, for \$66.00.

All business communications should be addressed to THE JOHNS HOPKINS PRESS, BALTIMORE, MARYLAND.



PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

HD
1739
U8B7

Brough, Charles Hillman,
Irrigation in Utah

UTL AT DOWNSVIEW



D RANGE BAY SHLF POS ITEM C
39 15 06 13 01 003 0